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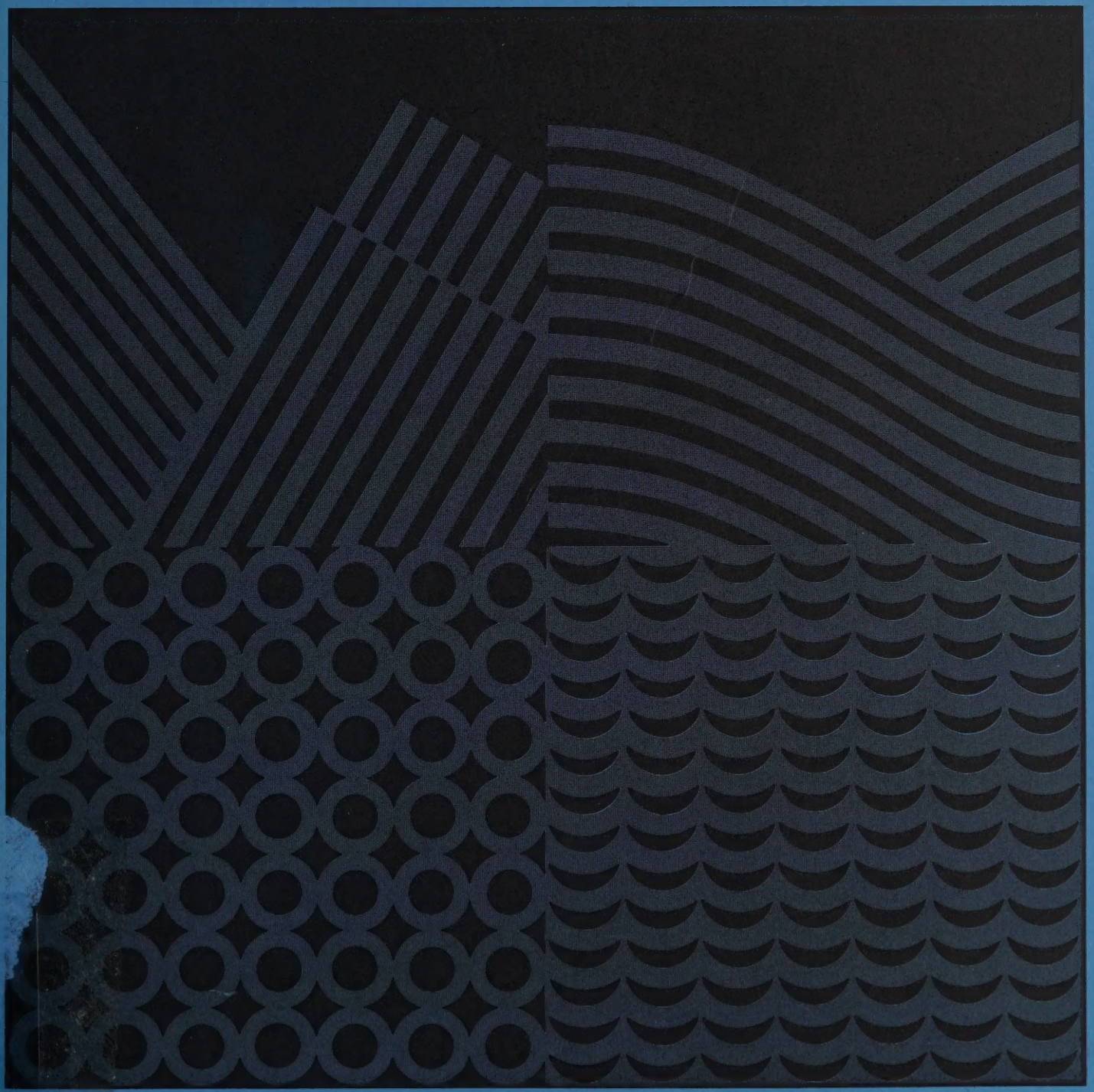
Proposed Mining Plan, Dry Fork Mine, Campbell County, Wyoming

Final
Environmental Impact
Statement OSMRE-EIS-24

U.S. Department of the Interior
Office of Surface Mining Reclamation and Enforcement



U.S. Department of the Interior
Office of Surface Mining Reclamation and Enforcement

Proposed Mining Plan, Dry Fork Mine, Campbell County, Wyoming

Final Environmental Impact Statement
OSMRE-EIS-24

March 1989

Type of Action: Administrative

Prepared by the
U.S. Office of Surface Mining Reclamation and Enforcement
in cooperation with the
U.S. Bureau of Land Management

Director

United States Department of the Interior

OFFICE OF SURFACE MINING
RECLAMATION AND ENFORCEMENT
BROOKS TOWERS
1020 15TH STREET
DENVER, COLORADO 80202

TAKE PRIDE IN AMERICA

In Reply Refer To:

4441
600-07

March 1, 1989

To All Interested Parties:

The enclosed environmental impact statement (EIS) has been prepared by the Office of Surface Mining Reclamation and Enforcement (OSMRE) and is available for public review. The EIS analyzes the impacts on the quality of the human environment that could result from approval and subsequent development of the life-of-mine mining plan for Phillips Petroleum Company's (PPC's) proposed Dry Fork surface coal mine.

A draft EIS was released by OSMRE for public review and comment on April 11, 1988. Seventeen comment letters regarding the EIS were received during the public comment period, which ended June 13, 1988. OSMRE suggested that a formal public comment meeting on the draft EIS could be held during the comment period in Gillette, Wyoming, if substantial interest were shown. No interest in such a meeting was expressed.

While not containing any major changes from the draft EIS, the final EIS contains corrections and clarifications of the original text. Summaries of the substantive public comments and responses from OSMRE have also been included. Alternative 1: approval of the proposed mining plan with conditions, remains the agency's preferred alternative.

After publication of this EIS, the Secretary of the Interior must make a decision whether to approve or disapprove PPC's mining plan. The Secretary can make this decision no sooner than 30 days after the Environmental Protection Agency publishes their Federal Register notice of availability of the final EIS.

Further information, and/or additional copies of this EIS, can be obtained by contacting Floyd McMullen at the OSMRE address given above or by telephone at (303) 844-3104.

Sincerely,

Peter A. Rutledge, Chief
Federal Programs Division

Enclosure

COVER SHEET

Proposed action: Approval of a mining plan submitted by Phillips Petroleum Company for the Dry Fork mine.

Type of statement: Final environmental impact statement (EIS)

Lead agency: Office of Surface Mining Reclamation and Enforcement (OSMRE)

Cooperating agency: Bureau of Land Management (BLM)

For further information:

Raymond L. Lowrie, Assistant Director
Attn: Floyd McMullen
OSMRE, Western Field Operations
1020 -15th Street
Brooks Towers, Second Floor
Denver, Colorado 80202

(303) 844-3104 (commercial)
564-3104 (FTS)

Abstract:

Phillips Petroleum Company proposes to develop the Dry Fork surface coal mine approximately 5 miles north and east of the city of Gillette, in Campbell County, Wyoming. The mine would eventually cover 3,798.49 acres, of which, 2,905.0 acres would eventually be disturbed. It would produce a maximum of 15 million tons of coal per year and would eventually remove a total of 226.4 million tons of coal over the 34 years of its proposed life. The impact of this disturbance on certain aspects of the environmental resources of hydrology and wildlife would be significant. The impact on certain aspects of the environmental resources of wildlife, socioeconomics, recreation, transportation, and cultural resources has the potential to become significant.

There are 21 existing or proposed coal mines in Campbell County. Six existing and two proposed mines (including the proposed Dry Fork mine) are contiguous to each other in a 7-mile-wide by 12-mile-long strip in the area north and east of Gillette. All together, the life-of-mine (permit) areas of these eight mines total 30,424 acres. Upon completion of mining, the eight mines would have disturbed about 21,744 acres and produced about 2.1 billion tons of coal. The cumulative impacts of mining the eight mines on certain aspects of the environmental resources of hydrology and wildlife would be significant. The cumulative impacts on certain aspects of the environmental resources of wildlife, socioeconomics, recreation, transportation, and cultural resources have the potential to become significant.

PREFACE

The Surface Mining Control and Reclamation Act of 1977 requires the Secretary of the Interior to approve, disapprove, or conditionally approve the mining plan Phillips Petroleum Company (PPC) has submitted to the Office of Surface Mining Reclamation and Enforcement (OSMRE) for its proposed Dry Fork mine. This environmental impact statement (EIS) identifies and analyzes the probable impacts to the human environment that would result from surface coal mining operations at the proposed Dry Fork mine should the Secretary approve and PPC subsequently implement the mining plan.

The EIS consists of seven chapters and four appendices. Chapter I describes the proposed Federal action and the purpose of and need for an action; it also provides background information regarding the proposed Dry Fork mine and identifies its relation to other development in the area north and east of Gillette, Wyoming. Chapter II describes and compares the alternative decisions available to the Secretary on Phillips Petroleum Company's mining plan and describes those alternatives that were considered but eliminated from detailed analysis. The alternatives available to the Secretary are: approval of the proposed mining plan, with conditions (alternative 1); approval of the proposed mining plan, with additional mitigation measures over and above the conditions of approval imposed under alternative 1 (alternative 2); and disapproval of the proposed mining plan (alternative 3). Alternative 1 is OSMRE's preferred alternative.

Chapter III describes the environment that would be affected by mining and related activities at the proposed Dry Fork mine. Chapter IV describes and analyzes the environmental impacts that would result from implementing each of the three prospective alternatives.

Chapter V describes the public participation activities that have been conducted relative to the EIS, discusses issues or concerns (i.e., impact topics) that were not analyzed in chapter IV, and lists the government agencies and private organizations from which OSMRE solicited comments on the draft document. Chapter VI lists, with their qualifications, the individuals who prepared both the environmental analyses contained in the document and the document itself. References cited in the EIS are listed in chapter VII.

Appendices have been included to provide supplemental information on specific aspects of the proposed Dry Fork coal mine, on cumulative coal development in the area, and on OSMRE's hydrologic analysis of Moyer Springs. Written comments OSMRE received on the draft EIS and OSMRE's responses to those comments have been included in appendix C.

SUMMARY

This environmental impact statement (EIS) identifies and analyzes the probable impacts to the quality of the human environment that would result should the Secretary of the Interior approve the mining plan for, and Phillips Petroleum Company (PPC) subsequently develop, the proposed Dry Fork mine. The EIS also identifies and analyzes probable cumulative impacts that would result from surface coal mining operations not only at the proposed Dry Fork mine but at the six existing mines (AMAX Coal Company, Eagle Butte mine; Carter Mining Company, Rawhide mine; Frontier Coal Company, Fort Union mine; Kerr-McGee Coal Corporation, Clovis Point mine; Triton Coal Company, Buckskin mine; and Wyodak Resource Development Corporation, Wyodak mine) and one proposed mine (Kerr-McGee Coal Corporation, East Gillette Federal mine) located in its vicinity north and east of Gillette, Wyoming.

Before the Office of Surface Mining Reclamation and Enforcement (OSMRE) completed the EIS, the Wyoming Department of Environmental Quality (DEQ) prepared a technical environmental analysis of PPC's permit application package (PAP) to determine its compliance with the Wyoming Environmental Quality Act. Wyoming DEQ issued PPC a Wyoming State program permit to mine coal for the Dry Fork mine on April 10, 1987. PPC submitted a PAP to OSMRE for approval of its mining plan in accordance with the requirements of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.), the Surface Mining Control and Reclamation Act of 1977 (SMCRA; 30 U.S.C. 1201 et seq.), and the Department of the Interior's Federal lands cooperative agreement with the State of Wyoming.

Brief description of the proposal

PPC proposes to develop the Dry Fork surface coal mine in the eastern Powder River Basin, Campbell County, Wyoming, 5 miles north and east of the city of Gillette. The life-of-mine (permit) area for the proposed mine, comprising 3,798.49 acres, is currently used for ranching and wildlife habitat. Mining the proposed life-of-mine area, PPC would extract 226.4 million tons of low-sulfur subbituminous coal over 34 years and, in the process, would disturb 2,905.0 acres. The peak annual production rate from the mine would be 15 million tons.

Altogether, the life-of-mine areas for the proposed Dry Fork mine and the other six existing and one proposed mines north and east of Gillette comprise 30,424 acres. Upon completion of mining, mining and related activities at these eight mines would have disturbed about 21,744 acres and produced about 2.1 billion tons of coal.

Purpose and need for a Federal decision

PPC has met all the terms of its Federal coal leases and has submitted a complete PAP to OSMRE to mine the coal at the proposed Dry Fork mine. Therefore, the Mineral Leasing Act of 1920, as amended, SMCRA, and the Department of the Interior's Federal lands cooperative agreement with the State of Wyoming require the Secretary of the Interior to approve, disapprove, or conditionally approve the mining plan submitted by PPC. This EIS identifies and analyzes the probable environmental consequences of development that would

result should each of three prospective Federal actions, or decisions, available to the Secretary be implemented.

The first alternative decision available to the Secretary is to approve th proposed mining plan, with the conditions Wyoming DEQ applied to bring it int compliance with Federal and State regulations and with the additional conditions c mining plan approval (alternative 1); OSMRE has chosen this alternative as it "preferred alternative." The second alternative decision available to the Secretar is to approve the proposed mining plan, with additional mitigation measures ove and above the conditions that would be imposed under alternative 1 (alternative 2) The third alternative decision available to the Secretary is to disapprove the proposed mining plan (alternative 3).

Comparison of alternatives

This EIS addresses both the site-specific impacts to the human environment that could result from mining the proposed Dry Fork mine and the cumulative impacts to the human environment that could result from mining the eight existing and proposed surface coal mines (including the proposed Dry Fork mine) north and east of Gillette. The cumulative impacts that could result from implementing alternatives 1 and 2 are those impacts that would be attributable to mining all eight existing and proposed mines north and east of Gillette, including the proposed Dry Fork mine. The cumulative impacts that could result from implementing alternative 3 are those impacts that would be attributable to mining seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine.

Under alternative 1 (approval of the proposed mining plan, with conditions), OSMRE's analyses found that:

- Significant impacts would be expected to occur to the (1) quantity of flow from Moyer Springs (site specific/cumulative), (2) water levels in appropriated wells in the coal aquifer (cumulative), and (3) brook trout population in Moyer Springs Creek from increased fishing pressure (site specific/cumulative).

- Impacts that have the potential to become significant include those to the (1) brook trout population from flow reductions in Moyer Springs (site specific/cumulative), (2) golden eagle pair nesting near the Dry Fork minesite (site specific), (3) migratory birds of high Federal interest (cumulative), (4) wildlife from secondary impacts (site specific/cumulative), (5) employment, personal income, and population after mine activity begins to cease (site specific/cumulative), (6) public recreation facilities at Keyhole State Park (site specific/cumulative), (7) traffic flow around Gillette (site specific/cumulative), and (8) undiscovered cultural resources sites (site specific/cumulative).

- Moderate impacts would be expected to occur to the (1) air quality within the mine area (site specific/cumulative), (2) water levels in the Tullock aquifer (site specific/cumulative), (3) raptors (site specific/cumulative), (4) red-tailed hawks nesting near the minesite (site specific), (5) migratory birds of high Federal interest (i.e., ferruginous hawks and burrowing owls; site

specific), (6) pronghorn (site specific/cumulative), (7) sage grouse (site specific/cumulative), (8) employment, personal income, and population during active mining operations (site specific/cumulative), and (9) public safety from increased coal train traffic (site specific/cumulative).

- Minor impacts would be expected to occur to the (1) scoria (porcellanite) resources within the life-of-mine area (site specific), (2) topography from lowering and flattening the life-of-mine area (site specific/cumulative), (3) erosional stability of long, postmining slopes (site specific), (4) wetland vegetation from flow reductions in Moyer Springs Creek (site specific/cumulative), (5) bottomland vegetation (site specific), (6) migratory birds of high Federal interest (i.e., mountain plovers; site specific), (7) mule deer (site specific/cumulative), (8) the housing in the Gillette area (site specific/cumulative), (9) public sector fiscal conditions (site specific/cumulative), (10) social well-being (site specific/cumulative), (11) recreational facilities in Gillette and Campbell County (site specific/cumulative), (12) traffic flow in Gillette (site specific/cumulative), (13) historic and prehistoric sites (site specific/cumulative), and (14) the visibility at Devils Tower National Monument (site specific/cumulative).

Under alternative 2 (approval of the proposed mining plan, with additional mitigation measures over and above the conditions of approval imposed under alternative 1), OSMRE reanalyzed the probable impacts and found that no change in either the impact analyses or the impact conclusions presented under alternative 1 was evident for the majority of the environmental resources. The following impacts under alternative 2 differ from those under alternative 1:

- Significant impacts to the quantity of flow from Moyer Springs (site specific/cumulative) would be reduced to negligible.

- Significant impacts to the brook trout population in Moyer Springs Creek from increased fishing pressure (site specific/cumulative) would be reduced to negligible.

- The potential for significant impacts to the brook trout population from flow reductions in Moyer Springs (site specific/cumulative) would be reduced to negligible.

- The potential for significant impacts to the golden eagle pair nesting near the Dry Fork minesite (site specific) would be reduced to moderate.

- Moderate impacts to raptors (site specific) would be reduced to minor.

- Minor impacts to wetland vegetation from flow reductions in Moyer Springs Creek (site specific/cumulative) would be reduced to negligible.

Under alternative 3 (disapproval of the proposed mining plan), OSMRE reanalyzed the probable impacts and found that, because the Dry Fork property would not be mined, no site-specific impacts would occur to the majority of environmental resources. Because seven of the eight mines north and east of Gillette would still be mined under this alternative, cumulative impacts would be similar to, but of lesser magnitudes than, those identified and analyzed under alternative 1 for the majority of the environmental resources. The following impacts under alternative 3 differ from those under alternative 1:

- Significant impacts to the quantity of flow from Moyer Springs (cumulative) would be reduced to negligible.
- Significant impacts to the brook trout population in Moyer Springs Creek from increased fishing pressure (cumulative) would be reduced to negligible.
- The potential for significant impacts to the brook trout population from flow reductions in Moyer Springs (cumulative) would be reduced to minor.
- The potential for significant impacts to the golden eagle pair nesting near the Dry Fork minesite (site specific) would be reduced to negligible.
- Minor impacts to wetland vegetation from flow reductions in Moyer Springs Creek (cumulative) would be reduced to negligible.

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CHAPTER I

INTRODUCTION

A. PURPOSE AND NEED FOR A FEDERAL DECISION

The Office of Surface Mining Reclamation and Enforcement (OSMRE) has received a complete permit application package (PAP) from the Phillips Petroleum Company of Bartlesville, Oklahoma (PPC). The PAP contains a mining plan for the proposed Dry Fork mine in Campbell County, Wyoming.

PPC has met all the terms of its Federal coal leases and submitted the PAP pursuant to the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The Mineral Leasing Act of 1920, as amended, SMCRA, and the Department of the Interior's Federal Lands Cooperative Agreement with the State of Wyoming require the Secretary of the Interior to approve, conditionally approve, or disapprove the mining plan submitted by PPC.

OSMRE has determined that the approval or disapproval of PPC's mining plan constitutes a major Federal action "significantly affecting the quality of the human environment" and, pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended (NEPA), requires the preparation of an environmental impact statement (EIS).

B. ROLES OF FEDERAL AND STATE AGENCIES IN MINE PLAN PERMITTING

SMCRA gives OSMRE primary responsibility to administer programs that regulate surface coal mining operations on Federal lands and the surface effects of underground coal mining operations on these same lands. Pursuant to Section 503 of SMCRA, the Wyoming Department of Environmental Quality (DEQ) developed, and the Secretary of the Interior approved, a permanent program authorizing Wyoming DEQ to regulate surface coal mining operations and the surface effects of underground coal mining on non-Federal lands within the State of Wyoming. In January 1987, pursuant to Section 523(c) of SMCRA, Wyoming DEQ entered into a cooperative agreement with the Secretary of the Interior authorizing Wyoming DEQ to regulate surface coal mining operations and the surface effects of underground mining on Federal lands within the State.

Pursuant to the cooperative agreement, Federal coal leaseholders in Wyoming must submit PAP's to OSMRE and Wyoming DEQ for proposed mining and reclamation operations on Federal lands in the State. Wyoming DEQ reviews the PAP to ensure that the permit application complies with the permitting requirements and that the coal mining operation will meet the performance standards of the approved permanent program; if it does comply, Wyoming DEQ issues the lessee a permit to conduct coal mining operations. OSMRE and other Federal agencies review the PAP to ensure that it complies with the terms of the coal lease, the requirements of the Mineral Leasing Act of 1920 (as defined in SMCRA), NEPA, and other Federal laws and their attendant regulations. OSMRE recommends approval, approval with conditions, or disapproval of the mining plan contained in the PAP to the Assistant Secretary for Land and MineralsManagement. Before the mining plan can be approved, the Bureau of Land

Management (BLM) and the surface managing agency (if that agency is not BLM) must concur with this recommendation.

Wyoming DEQ enforces the performance standards and permit requirements during operation of the mine and has primary authority in emergency environmental situations. OSMRE retains oversight responsibility for this enforcement. BLM has authority in those emergency situations where Wyoming DEQ or OSMRE inspectors are unable to take action before significant harm or damage to the environment occurs.

C. THE APPLICANT'S PROPOSAL

PPC, the applicant, proposes to develop the Dry Fork surface coal mine in the Eastern Powder River Basin of Wyoming, approximately 5 miles north and east of the city of Gillette. (See figure I-1.) The mine would eventually cover 3,798.49 acres of State and private surface lands, 75 percent of which overlies Federal coal (leases W-0271199, W-0271200, and W-0271201). The Dry Fork mine would be in operation for approximately 34 years, from premining construction and development through bond release after final reclamation. It would produce a maximum of 15 million tons of coal per year and eventually remove a total of 226.4 million tons of coal over the life of the mine. The project would consist of four separate mining areas: the northwest area, the south advance area, the southwest area, and the east advance area. These mining areas, together with the mine facilities area, would eventually disturb a total of 2,905.0 acres within the 3,798.49-acre permit area. Coal would be extracted using truck-and-shovel, open pit methods. Processed coal would be transported by conveyor to coal storage silos located on a rail loop adjacent to Burlington-Northern Railroad Company's branch line.

PPC has proposed an initial permit term for the mine, during which it would be restricted to 1,045 acres of surface disturbance within the 3,798.49-acre permit area. Upon successful compliance with the approved permit, PPC would be entitled to successive permit renewals in 5-year increments until the entire 226.4 million tons of coal were removed.

Table I-1 compares the acreages PPC proposes for permitting with those it proposes for disturbance during the initial permit term and life-of-mine periods; it also shows the surface and coal ownership of the life-of-mine area and details the duration of each of the phases of the proposed 34-year operation. Table I-2 shows the projected annual coal production, disturbed and reclaimed acreages, and number of persons employed at the mine throughout its 34-year life. Plate 1 shows PPC's proposed life-of-mine permit boundary and disturbed acreage boundary; it also shows the locations of the major topsoil and overburden stockpiles, water control structures, and various mine support facilities being proposed.

Specific details of PPC's proposal are included in appendix A. Copies of PPC's PAP and of data supporting it can be reviewed by the public at OSMRE, Western Field Operations, 1020 - 15th Street, Brooks Towers, Second Floor, Denver, Colorado; OSMRE, Casper Field Office, 100 East B Street, Federal Building, Room 2128, Casper, Wyoming; and Wyoming DEQ, 122 West 25th Street, Herschler Building, Third Floor, Cheyenne, Wyoming.

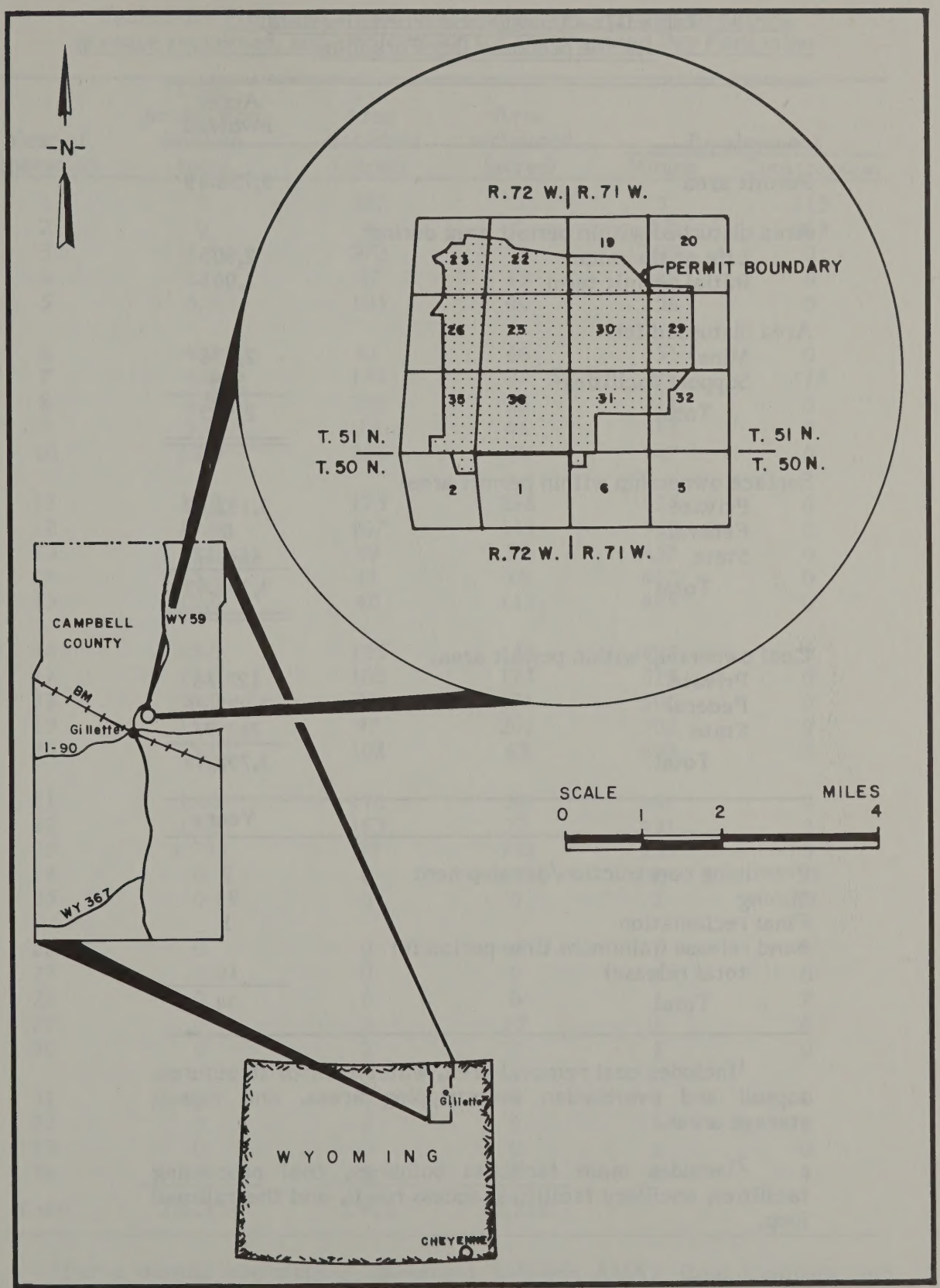

Figure I-1.--Location of the proposed Dry Fork mine.

Table I-1.--Acreage and scheduling data for the proposed Dry Fork mine

	Acres involved
Permit area	3,798.49
Area disturbed within permit area during:	
Life of the mine	2,905
Initial permit term	1,045
Area disturbed for:	
Mine[1]	2,576
Support facilities[2]	329
Total	2,905
Surface ownership within permit area:	
Private	3,132.32
Federal	0
State	666.17
Total	3,798.49
Coal ownership within permit area:	
Private	127.76
Federal	2,928.76
State	741.97
Total	3,798.49
	Years
Premining construction/development	2
Mining	21
Final reclamation	1
Bond release (minimum time period for total release)	10
Total	34

[1]Includes coal removal area, water control structures, topsoil and overburden overstripping areas, and topsoil storage areas.

[2]Includes main facilities buildings, coal processing facilities, ancillary facilities, access roads, and the railroad loop.

Table I-2.--Projected annual coal production, acreage disturbed, acreage reclaimed, and employment for the proposed Dry Fork mine

Year of operation	Coal production (million tons)	Area disturbed (acres)	Area reclaimed (acres)	Employment	
				Mining	Construction
1	0	382	0	5	115
2	0	4	0	27	163
3	1.5	272	0	135	0
4	3.0	87	19	145	0
5	3.2	105	44	156	0
6	4.0	61	66	151	0
7	6.0	134	27	214	115
8	6.0	208	56	211	0
9	9.0	78	46	313	0
10	12.0	284	84	347	0
11	15.0	175	228	475	0
12	15.0	167	115	522	0
13	15.0	59	77	457	0
14	15.0	11	76	417	0
15	15.0	40	112	444	0
16	15.0	138	158	492	0
17	15.0	102	125	513	0
18	15.0	85	171	500	0
19	15.0	97	241	502	0
20	15.0	108	63	459	0
21	15.0	110	58	447	0
22	15.0	163	77	431	0
23	1.733	35	350	230	0
24	0	0	683	39	35
25	0	0	0	2	17
26	0	0	0	1	4
27	0	0	0	1	0
28	0	0	0	1	7
29	0	0	12	1	0
30	0	0	0	1	0
31	0	0	0	1	0
32	0	0	0	1	0
33	0	0	0	1	0
34	0	0	0	1	4
Total	226.433	2,905	[1]2,888		

[1]Per a mutual backsloping agreement between AMAX Coal Company and PPC, AMAX Coal Company, operating out of its Eagle Butte mine, would reclaim the remaining 17 acres.

D. RELATION TO OTHER COAL DEVELOPMENT IN THE AREA

There are 21 existing or proposed coal mines in Campbell County. (See figure I-2.) Six existing and two proposed mines are contiguous to each other in a 7-mile-wide by 12-mile-long strip in the area north and east of Gillette, Wyoming. The existing mines in this strip are (1) the Buckskin mine, operated by Triton Coal Company, a division of Shell Oil Company; (2) the Rawhide mine, operated by Carter Mining Company, a division of Exxon Coal USA, Inc., (3) the Eagle Butte mine, operated by AMAX Coal Company, (4) the Fort Union mine, operated by Frontier Coal Company, (5) the Clovis Point mine, operated by Kerr-McGee Coal Corporation, and (6) the Wyodak mine, operated by Wyodak Resource Development. The proposed mines are (1) the Dry Fork mine, to be operated by PPC, and (2) the East Gillette Federal mine, to be operated by Kerr-McGee Coal Corporation.

Altogether, the life-of-mine (permit) areas for these eight mines total 30,424 acres. Upon completion of mining, the eight mines would have disturbed about 21,744 acres and produced about 2.1 billion tons of coal (table I-3). Plate 2 shows the life-of-mine permit area boundaries and the disturbed acreage boundaries for all eight mines. Appendix B gives specific details of the mining operations for the seven mines other than the proposed Dry Fork mine.

In the year 2012 (approximate), when the Dry Fork mine would have completed mining and reclamation activities, at least three of the other seven mines could still be actively mining coal (East Gillette Federal, Fort Union, and Wyodak). By 2022 (approximate), when the Dry Fork mine would have met all reclamation standards, all the other seven mines should have ceased coal extraction operations. The last of the eight mines to cease active coal mining (assuming no additional mine acreage were to be developed) would be the Fort Union mine in approximately 2019.

E. SCOPE OF THE EIS ANALYSIS

OSMRE, BLM, and the U.S. Geological Survey (USGS) have prepared several EIS's evaluating these and/or other surface coal mining operations in the eastern Powder River Basin (Office of Surface Mining Reclamation and Enforcement, 1984; Bureau of Land Management, 1974, 1979a; U.S. Geological Survey, 1977a, b). In addition, BLM has prepared EIS's evaluating coal leasing and resource management in the basin (Bureau of Land Mangement, 1979b, 1985a, b).

OSMRE prepared this EIS to analyze the probable impacts to the human environment that would result from the proposed surface coal mining operations at the Dry Fork mine in terms of both its site-specific and its cumulative aspects:

- The site-specific parts of the analysis address the impacts that would result from developing the applicant's proposed mining and reclamation operations both on and off the specific areas targeted for disturbance over the proposed life of the Dry Fork mine.

- The cumulative parts of the analysis address the incremental impacts that would result from developing the applicant's proposed mining and reclamation operations on the area as a whole (i.e., the incremental impacts from adding the proposed operations to other past, present, and reasonably foreseeable future actions in the

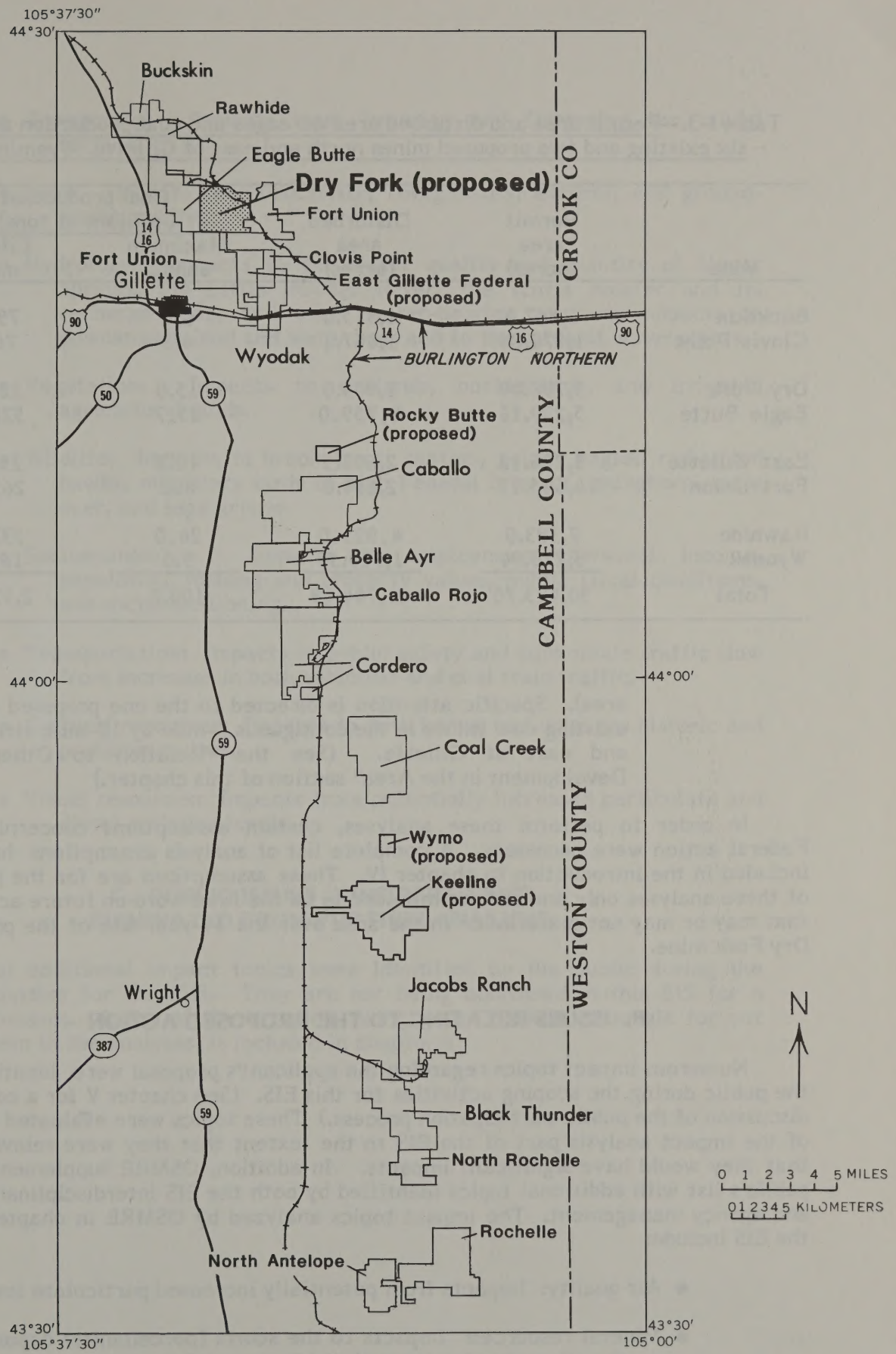

Figure I-2.--Location of existing and proposed coal mines in Campbell County, Wyoming.

Table I-3.--Permit area and disturbed area acreages and coal production at the six existing and two proposed mines north and east of Gillette, Wyoming

Mine	Permit area (acres)	Disturbed area (acres)	Coal production (millions of tons)	
			Maximum annual	Life of mine
Buckskin	1,467.0	1,315.0	6.2	79.0
Clovis Point	1,370.83	1,067.1	4.3	76.3
Dry Fork	3,798.49	2,905.0	15.0	226.4
Eagle Butte	5,229.16	4,759.0	25.7	528.3
East Gillette	3,246.15	2,603.5	12.3	256.0
Fort Union	4,645.13	2,454.0	8.2	265.8
Rawhide	7,393.0	4,921.0	24.0	532.8
Wyodak	3,273.94	1,719.59	5.0	165.3
Total	30,423.70	21,744.19	100.7	2,129.9

area). Specific attention is directed to the one proposed and six existing coal mines in the contiguous 7-mile by 12-mile strip north and east of Gillette. (See the "Relation to Other Coal Development in the Area" section of this chapter.)

In order to perform these analyses, certain assumptions concerning the Federal action were necessary. A complete list of analysis assumptions has been included in the introduction to chapter IV. These assumptions are for the purpose of these analyses only and are not intended to be the final word on future activities that may or may not materialize in the area over the 34-year life of the proposed Dry Fork mine.

F. ISSUES RELATING TO THE PROPOSED ACTION

Numerous impact topics regarding the applicant's proposal were identified by the public during the scoping activities for this EIS. (See chapter V for a complete discussion of the public-participation process.) These topics were evaluated as part of the impact analysis part of the EIS to the extent that they were relevant and that they would have significant impacts. In addition, OSMRE supplemented the public's list with additional topics identified by both the EIS interdisciplinary team and agency management. The impact topics analyzed by OSMRE in chapter IV of the EIS include:

- Air quality: Impacts from potentially increased particulate levels.
- Mineral resources: Impacts to the scoria (porcellanite) deposits and the oil production located within the mining areas.

- Topography: Impacts from lowering and flattening the mined surface.

- Soils: Impacts to productivity, revegetation success, and groundwater quality.

- Hydrology: Impacts to the water quality and quantity of Moyer Springs, the Little Powder River, the scoria aquifer and its recharge zone, and other water-bearing aquifers; impacts to downstream land and water uses and to the value of water rights.

- Vegetation: Impacts to wetlands, bottomlands, and irrigated agricultural lands.

- Wildlife: Impacts to brook trout, raptors, golden eagles, red-tailed hawks, migratory birds of high Federal interest, pronghorn, mule deer, and sage grouse.

- Socioeconomics: Impacts to employment, personal income, population, housing and property values, public fiscal conditions, and social well-being.

- Transportation: Impacts to public safety and automobile traffic flow from increases in both vehicular and coal train traffic.

- Cultural resources: Impacts to both known and unknown historic and prehistoric sites.

- Visual resources: Impacts from potentially increased particulate and diesel-emission levels.

G. PUBLIC ISSUES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

Several additional impact topics were identified by the public during the scoping activities for this EIS. They are not being addressed in this EIS for a variety of reasons. A list of these topics, along with OSMRE's rationale for not including them in the analyses, is included in chapter V.

CHAPTER II

ALTERNATIVES

This EIS evaluates three prospective Federal actions that constitute the range of alternative decisions available to the Secretary of the Interior regarding PPC's life-of-mine mining plan for its proposed Dry Fork mine.

A. DESCRIPTION OF THE ALTERNATIVES ANALYZED

1. Alternative 1: Approval Of The Proposed Mining Plan, With Conditions

Under this alternative, the Secretary of the Interior would approve the applicant's life-of-mine mining plan (summarized in appendix A), subject to (1) the conditions (appendix A) Wyoming DEQ applied to bring it into compliance with the minimum requirements of SMCRA, the Wyoming Environmental Quality Act (WEQA), and all other applicable Federal laws, such as the Federal Land Policy and Management Act, the Endangered Species Act, the National Historic Preservation Act, the Archeological and Historic Preservation Act, the Antiquities Act, the Clean Air Act, and the Federal Water Pollution Control Act, as amended (i.e., the Clean Water Act) and (2) the additional conditions of mining plan approval. This is OSMRE's "preferred" alternative. For PPC's proposed Dry Fork mine, the conditions of mining plan approval would be as follows:

- Condition No. 1.--The mining plan approval is issued pursuant to Federal coal leases W-0271199, W-0271200, and W-0271201; the Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.); and, in the case of acquired lands, the Mineral Leasing Act for Acquired Lands of 1947, as amended (30 U.S.C. 351 et seq.). This mining plan approval is subject to all applicable regulations of the Secretary of the Interior, including but not limited to 30 CFR Chapter VII and 43 CFR Group 3400, and to all regulations of the Secretary of Energy, which are now or hereafter in force, and all such regulations are made a part hereof. The lessee/operator shall comply with the provisions of the Federal Water Pollution Control Act (33 U.S.C. 1151 et seq.), the Clean Air Act (42 U.S.C. 7401 et seq.), and other applicable Federal laws.

- Condition No. 2.--The mining plan approval document approves the Dry Fork mine mining plan, updated through April 14, 1986, and authorizes coal development or mining operations on Federal lands within the area of mining plan approval pursuant to a valid permit issued by Wyoming DEQ.

- Condition No. 3.--The lessee/operator shall conduct coal development and mining operations only as described in the complete PAP as updated and approved by Wyoming DEQ, except as otherwise directed in the conditions added to the mining plan approval.

- Condition No. 4.--The lessee/operator shall comply with the terms and conditions of the lease and the approved mining plan and with the requirements of Wyoming permit No. 599-T1, issued under the Wyoming State program and approved pursuant to SMCRA (30 U.S.C. 1201 et seq.).

- Condition No. 5.--The mining plan approval shall be binding on any person conducting coal development or mining operations under the approved mining plan and shall remain in effect until superseded, cancelled, or withdrawn.

- Condition No. 6.--The lessee/operator shall allow the authorized representatives of the Secretary and of Wyoming DEQ, without advance notice or a search warrant, upon presentation of appropriate credentials, and without delay to (1) have the rights-of-entry provided for in 30 CFR 842.13, 43 CFR Group 3400, and W.S. 35-11-109(a)(vi); and (2) be accompanied by private persons for the purpose of conducting an inspection in accordance with 30 CFR 842.12 and with Wyoming DEQ Land Quality Division Rules and Regulations, Section 1.c., when the inspection is in response to an alleged violation reported by the private persons.

- Condition No. 7.--If, during mining operations, previously unidentified prehistoric or historic resources are discovered, the lessee/operator shall ensure that the resources are not disturbed and shall notify Wyoming DEQ and OSMRE. The lessee/operator shall take such necessary actions as are required by Wyoming DEQ, in coordination with OSMRE.

- Condition No. 8.--The lessee/operator shall comply with the terms and conditions set out in the leases, Wyoming permit No. 599-T1, and the mining plan approval.

- Condition No. 9.--Prior to disturbing any wet bottomland acreage, the lessee/operator shall--
  - (a) survey all wet bottomland vegetation types for the identification and delineation of potential wetlands;
  - (b) identify the importance of any potential wetland to the vegetative and wildlife diversity of the area;
  - (c) submit a draft mitigation plan for the postmining replacement of any potential wetland acreage that is identified for approval by OSMRE and Wyoming DEQ;
  - (d) coordinate any approved mitigation plan with the U.S. Army Corps of Engineers.

2. Alternative 2: Approval Of The Proposed Mining Plan, With Additional Mitigation Measures Over And Above The Conditions Of Approval Imposed Under Alternative 1

Under this alternative, the Secretary of the Interior would approve the applicant's life-of-mine mining plan (summarized in appendix A), subject to the following additional mitigation over and above (1) the conditions Wyoming DEQ applied to bring it into compliance with the minimum requirements of SMCRA, WEQA, and all other applicable Federal laws, and (2) the additional conditions of

mining plan approval (imposed under alternative 1). The additional mitigation would be:

- Condition No. 10.--PPC shall drill a well in the scoria (porcellanite) aquifer prior to mining to augment the flow of Moyer Springs Creek during the life of the mine. The water from this well shall be of similar quality (with respect to both its chemical constituents and its temperature) to the water currently in Moyer Springs Creek. The well shall be pumped at whatever rate is necessary to maintain streamflow at its premining rate. PPC shall monitor the creek both prior to and throughout mining to assure that the augmentation well maintains both the creek's premining quality and its premining flow rate.

- Condition No. 11.--PPC shall not allow any person to fish Moyer Springs Creek within the Dry Fork life-of-mine area.

- Condition No. 12.--PPC shall install and maintain artificial nest structures for raptors in those areas where mature cottonwoods are destroyed, from the period following initial reclamation until such time as planted cottonwoods have grown to a sufficient size, as judged by the regulatory authority, to support raptor nests. Such nest structures shall be of a design approved by the U.S. Fish and Wildlife Service (USFWS), Ecological Services, Cheyenne, Wyoming.

- Condition No. 13.--PPC shall monitor and maintain the physical condition and stability of the golden eagle nest platform in sec. 19, T. 51 N., R. 72 W., to assure that the platform remains suitable for golden eagle nesting. Monitoring shall be completed prior to January 15 of each year; necessary repairs shall be approved by USFWS, Ecological Services, Cheyenne, Wyoming. PPC's monitoring and maintenance responsibilities shall continue until planted cottonwoods have grown to a sufficient size, as judged by the regulatory authority, to support golden eagle nests.

3. Alternative 3: Disapproval Of The Proposed Mining Plan

Under this alternative, the Secretary of the Interior would disapprove the applicant's life-of-mine mining plan (summarized in appendix A) because it did not meet the requirements of the Mineral Leasing Act of 1920, as amended, and all other applicable Federal and State laws or because the proposal imposed, or had the potential to impose, unacceptable impacts on the human environment.

B. OTHER ALTERNATIVES CONSIDERED

The following alternatives were considered but eliminated from detailed analysis:

- The no action alternative was evaluated and determined not to be reasonable. PPC has fulfilled the requirement of its leases and has filed a complete PAP with OSMRE. Therefore, a decision by

the Secretary of the Interior on whether or not to approve the life-of-mine mining plan is required by law.

However, for OSMRE, the impacts to the human environment of implementing the no action alternative would be the same as those of disapproving the proposal (alternative 3). Thus, for the purpose of this EIS, these alternatives are considered equivalent, and the no action alternative is not analyzed further.

- Alternatives to the leasing and development of coal resources are inappropriate in the present analysis because PPC holds active Federal leases for the coal resources at the Dry Fork minesite. Therefore, these alternatives are not analyzed further.

C. COMPARISON OF ALTERNATIVES

Tables IV-4 and IV-5 give complete listings, by discipline, of all impact comparisons. In this chapter, tables II-1 and II-2 give selected listings of these comparisons. Summaries of the comparisons follow:

- Alternative 1 (approval of the proposed mining plan, with conditions): If the Secretary chose this alternative, significant impacts would be expected to occur to certain aspects of the environmental resources of hydrology and wildlife. Impacts that have the potential to become significant include certain aspects of the environmental resources of wildlife, socioeconomics, recreation, transportation, and cultural resources.

- Alternative 2 (approval of the proposed mining plan, with additional mitigating measures over and above the conditions of approval imposed under alternative 1): If the Secretary chose this alternative, the impacts of implementing alternative 1 would generally occur for most environmental resources; impacts to the environmental resources of vegetation, hydrology, and wildlife would be further reduced.

- Alternative 3 (disapproval of the proposed mining plan): If the Secretary chose this alternative, the cumulative impacts of implementing alternative 1 would generally occur, except at slightly reduced levels; impacts to the environmental resources of hydrology, vegetation, and wildlife would be further reduced. The incremental impacts to air quality, geology, topography, soils and overburden, hydrology, vegetation, wildlife, socioeconomics, recreation, transportation, cultural resources, and visual resources resulting from mining the proposed Dry Fork mine would not occur.

Table II-1.--Comparison, by alternative, of the intensity and duration of selected site-specific impacts that would result from mining the proposed Dry Fork surface coal mine

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Air quality			
Impacts to air quality from increased particulate levels.	Moderate, short term within life-of-mine area; minor, short term outside life-of-mine area. Negligible, long term.	Same as alternative 1.	No impact.
Hydrology			
Impact on the quantity of flow from Moyer Springs.	Significant, short term; negligible, long term.	Negligible, short and long term.[1]	No impact.
Impact on the quality of water in Moyer Springs and the Little Powder River.	Negligible, short term; moderate, long term.	Negligible, short term; moderate, long term.[1]	No impact.
Impacts of the proposed Dry Fork mine's water-supply well on water levels in the Tullock Member of the Fort Union Formation.	Moderate, short term; negligible, long term.	Same as alternative 1.	No impact.
Vegetation			
Impact of flow reductions in Moyer Springs Creek on wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek.	Minor, short term; negligible, long term.	Negligible, short and long term.[1]	No impact.
Wildlife			
Impacts on the brook trout population in Moyer Springs Creek from flow reductions in Moyer Springs.	Potential to become significant, short term; minor, long term.	Negligible, short term; minor, long term.[1]	No impact.
Impacts on the brook trout population in Moyer Springs Creek from increased fishing pressure.	Significant, short and long term.	Negligible, short term; no impact, long term.	No impact.

Table II-1.--Comparison, by alternative, of the intensity and duration of selected site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Wildlife--Continued			
Impacts on raptors from loss of nesting sites and of habitat that supports prey species.	Moderate, short term; minor, long term.	Minor, short and long term.[1]	No impact.
Impacts on golden eagles, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.	Potential to become significant, short term; moderate, long term.	Moderate, short and long term.[1]	No impact.
Impacts on migratory birds of high Federal interest, including ferruginous hawks and burrowing owls.	Moderate, short term;	Same as alternative 1.	No impact.
Impacts on the red-tailed hawk pair nesting in sec. 25., T. 51 N., R. 72 W.	Moderate, short term; minor, long term.	Same as alternative 1.	No impact.
Impacts on pronghorn of the Gillette and Black Hills Herd units.	Moderate, short and long term.	Same as alternative 1.	No impact.
Impacts on sage grouse of Management Area 43.	Moderate, short and long term.	Same as alternative 1.	No impact.
Socioeconomics			
Impacts on employment, personal income, and population in Gillette and Campbell County.	Moderate through year 17 (short term); potential to become significant beyond year 17 (short and long term).	Same as alternative 1.	No impact.
Recreation			
Impacts on public recreation facilities and services in Keyhole State Park.	Potential to become significant, short term; minor, long term.	Same as alternative 1.	No impact.

Table II-1.--Comparison, by alternative, of the intensity and duration of selected site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Transportation			
Impacts of increased traffic on public safety and traffic flow around Gillette.	Potential to become significant, short term; minor, long term.	Same as alternative 1.	No impact.
Impacts of increased coal train traffic on public safety and automobile traffic flow at at-grade railroad highway crossings.	Moderate, short term; minor, long term.	Same as alternative 1	No impact.
Cultural resources			
Impacts to undiscovered cultural resource sites, especially buried prehistoric sites in the vicinity of Moyer Springs and Moyer Springs Creek.	Potential to become significant, permanent.	Same as alternative 1.	No impact.

[1]The intensity of the impact identified under this alternative is less than the intensity identified for alternative 1; however, the reduction is not great enough to move it into the next lower level of intensity.

Table II-2.--Comparison by, alternative, of the intensity and duration of selected cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming

(Note that, under alternatives 1 and 2, all eight existing and proposed mines north and east of Gillette, including the proposed Dry Fork mine, would be mined. Under alternative 3, seven of these existing and proposed mines, excluding the proposed Dry Fork mine, would be mined)

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Air quality			
Impacts to air quality from increased particulate levels.	Moderate, short-term; minor, long-term.	Same as alternative 1.	Moderate, short-term; minor, long-term.[1]
Hydrology			
Impact on the quantity of flow from Moyer Springs.	Significant, short term; negligible, long term.	Negligible, short and long term.[1]	Negligible, short and long term.[1]
Impact on the quality of water in Moyer Springs and the Little Powder River.	Negligible, short term; moderate, long term.	Negligible, short term; moderate, long term.[1]	Negligible, short term; moderate, long term.[1]
Impact on water levels in existing appropriated wells developed in the coal aquifer, including wells for local ranching operations and the domestic wells serving the Garner Lake housing development.	Significant, short term; negligible, long term.	Significant, short term; negligible, long term.[1]	Significant, short term; negligible, long term.[1]
Impacts of the eight mines' water-supply wells on water levels in the Tullock Member of the Fort Union Formation.	Moderate, short term; minor, long term.	Same as alternative 1.	Moderate, short term; minor, long term.[1]
Vegetation			
Impact of flow reductions in Moyer Springs Creek on wetland vegetation adjacent to Moyer Springs Creek.	Minor, short term; negligible, long term.	Negligible, short and long term.[1]	Negligible, short and long term.[1]

Table II-2.--Comparison, by alternative, of the intensity and duration of selected cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Wildlife			
Impacts on brook trout population in Moyer Springs Creek from flow reductions in Moyer Springs.	Potential to become significant, short term; minor, long term.	Negligible, short term; minor, long term.[1]	Minor, short and long term.[1]
Impacts on brook trout population in Moyer Springs Creek from increased fishing pressure.	Significant, short and long term.	Negligible, short term; no impact, long term.	Negligible, short term; no impact, long term.
Impacts on raptors from loss of nesting sites and of habitat that supports prey species.	Moderate, short term; minor, long term.	Moderate, short term; minor, long term.[1]	Moderate, short term; minor, long term.[1]
Impacts on golden eagles, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.	Potential to become significant, short term; moderate, long term.	Moderate, short and long term.[1]	Negligible, short term; moderate, long term.[1]
Impacts on migratory birds of high Federal interest, including ferruginous hawks, burrowing owls, and mountain plovers.	Potential to become significant, short and long term.	Same as alternative 1.	Potential to become significant, short and long term.[1]
Impacts on pronghorn of the Gillette and Black Hills Herd units.	Moderate, short and long term.	Same as alternative 1.	Moderate, short and long term.[1]
Impacts on sage grouse of Management Area 43.	Moderate, short and long term.	Same as alternative 1.	Moderate, short and long term.[1]
Secondary impacts on wildlife from loss of habitat related to population growth and increased incidence of road kills, general harassment, and poaching.	Potential to become significant, short term; moderate, long term.	Same as alternative 1.	Potential to become significant, short term; moderate, long term.[1]

Table II-2.--Comparison, by alternative, of the intensity and duration of selected cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Socioeconomics			
Impacts on employment, personal income, and population in Gillette and Campbell County.	Moderate through 2005 (short term); potential to become significant beyond 2005 (short and long term).	Same as alternative 1.	Moderate through 2005 (short term); potential to become significant beyond 2005 (short and long term).[1]
Recreation			
Impacts on public recreation facilities and services in Keyhole State Park.	Potential to become significant, short term; minor, long term.	Same as alternative 1.	Potential to become significant, short term; minor, long term.[1]
Transportation			
Impacts of increased traffic on public safety and traffic flow around Gillette.	Potential to become significant, short term; minor, long term.	Same as alternative 1.	Potential to become significant, short term; minor, long term.[1]
Impacts of increased coal train traffic on public safety and automobile traffic flow at at-grade railroad-highway crossings.	Moderate, short term; minor, long term.	Same as alternative 1.	Moderate, short term; Minor, long term.[1]
Cultural resources			
Impacts to undiscovered cultural resource sites.	Potential to become significant, permanent.	Same as alternative 1.	Potential to become significant, permanent.[1]

[1]The intensity of the impact identified under this alternative is less than the intensity identified for alternative 1; however, the reduction is not great enough to move it into the next lower level of intensity.

CHAPTER III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. CLIMATE AND AIR QUALITY

1. Climate

The climate in northeastern Wyoming is semiarid and windy, characterized by wide variations in diurnal and annual temperature and in seasonal and annual precipitation. Approximately 50 percent of the annual precipitation occurs from April through June; 75 percent occurs from April through September (National Oceanic and Atmospheric Administration, 1973). Hailstorms are the most destructive storms affecting the area, occasionally occurring during summer thunderstorms. Average annual snowfall is about 55 inches per year in the Gillette area. Climatological records from 1931 to 1970 indicate that average annual precipitation in the Gillette area is approximately 14 inches per year. Potential evapotranspiration at Douglas, Wyoming (the nearest site for which data are available), is 23 inches per year (National Oceanic and Atmospheric Administration, 1969).

Diurnal temperature variations up to 40°F or 50°F are not uncommon during winter months in northeastern Wyoming. Summer daytime temperatures typically reach into the upper 80's or 90's and occasionally are over 100°F. Winter nighttime temperatures often dip below zero during clear sky and surface snow-cover conditions. Mean annual temperature at Gillette from 1941 to 1970 was 45.1°F. The coldest month (January) averages 22°F and the warmest month (July) averages 71°F. The growing season (frost-free days) lasts approximately 130 days, beginning in mid- to late May and ending in mid- to late September.

The average wind speed in the Gillette area is 12 miles per hour, although wind gusts over 50 miles per hour may occur rather frequently during the daytime. Regionally, winds are dominated by prevailing westerlies, modified by major topographic features into northwesterly winds. Secondary wind flow is from the southeast during the summer. The numerous low-relief features in the Gillette area, together with the prevailing westerly winds, are not conducive to the formation of long-duration temperature inversions. On the average, air stagnation events occur 15 times each year and last about 2 days (Bureau of Land Management, 1974).

Wind conditions at AMAX Coal Company's Eagle Butte mine, which is immediately adjacent to the Dry Fork property, are representative of wind conditions on that property. From 1982 to 1984, approximately 60 percent of the wind at the Eagle Butte minesite originated from the south to southwest sectors and northwest to north sectors (table III-1). The prevailing wind direction around the minesite was from the south during this period.

2. Air Quality

Effective July 1, 1987, the U.S. Environmental Protection Agency (EPA) promulgated new particulate standards for the first time in 17 years to reflect the potential public health risks and effects of particles with diameters of 10 microns

Table III-1.--Frequencies of wind from given compass directions at the Eagle Butte mine, February 1, 1982, to December 31, 1984[1]

(Source: Bernard J. Dailey, Wyoming Department of Environmental Quality, Air Quality Division, written communication, April 4, 1986. AMAX collected data given in this table at its Eagle Butte meteorological station, which measures wind at an elevation of 10 meters above ground level and is located in the NE¼ sec. 20, T. 51 N., R. 72 W.)

Wind direction	Frequency of wind from this direction (percent)
North	8.8
North-northeast	5.1
Northeast	3.4
East-northeast	2.3
East	1.4
East-southeast	1.5
Southeast	2.4
South-southeast	6.1
South	14.0
South-southwest	11.4
Southwest	7.9
West-southwest	7.3
West	5.5
West-northwest	5.0
Northwest	7.6
North-northwest	10.3
Total	100.0

[1]The Eagle Butte mine is immediately adjacent to the Dry Fork property. Therefore, frequencies of wind from given compass directions at the proposed Dry Fork mine would be comparable to frequencies given in this table.

or less (PM_{10}). Wyoming DEQ, Air Quality Division, adopted similar standards on December 13, 1988, except that Wyoming DEQ adopted PM_{10} as a "health" standard and maintained the 24-hour, maximum concentration, total suspended particulate (TSP) measurement as a "welfare" standard. The annual TSP measurement has been dropped as a standard in the State. TSP is defined as all particles less than 30 microns in diameter. Although PM_{10} and TSP are each measured in $\mu g/m^3$ units, annual concentrations of PM_{10} are reported as an

expected arithmetic mean value, whereas annual concentrations of TSP are reported as a geometric mean value. There is no accepted conversion factor that correlates PM_{10} and TSP annual and 24-hour standards with each other.

The State/Federal annual PM_{10} standard has been established at 50 $\mu g/m^3$ expected arithmetic mean and the 24-hour PM_{10} standard has been established at 150 $\mu g/m^3$. The maximum 24-hour concentration for TSP in the State of Wyoming remains at 150 $\mu g/m^3$.

Air quality impacts resulting from mining activities at the proposed Dry Fork mine would be evaluated based upon PPC's compliance with the Federal and State of Wyoming TSP standards in effect prior to July 1, 1987, because the air quality permit issued on November 19, 1986, by Wyoming DEQ, Air Quality Division, for the Dry Fork mine (permit No. CT-707) was based upon these standards. As a result, data contained in the approved air quality permit application are considered baseline information. Projected impacts as a result of the PM_{10} standards are based upon the magnitude of TSP impacts resulting from dispersion modeling analyses performed by the State of Wyoming. TSP standards in the State of Wyoming have historically been more restrictive than Federal requirements for both annual (60 $\mu g/m^3$ versus 75 $\mu g/m^3$) and 24-hour (150 $\mu g/m^3$ versus 260 $\mu g/m^3$) standards, respectively.

PPC collected ambient air quality data for TSP every 6 days, from November 1979 through June 1983, at a particulate monitoring station located on the Dry Fork property in NE¼NW¼ sec. 31, T. 51 N., R. 71 W., sixth principal meridian. Based on 170 data samples, PPC calculated that the maximum annual geometric-mean concentration on the property was 24.35 $\mu g/m^3$, which is 41 percent of the State annual geometric mean particulate standard of 60 $\mu g/m^3$; the maximum 24-hour concentration PPC monitored over this period was 62 $\mu g/m^3$, which is 41 percent of the State 24-hour geometric mean particulate standard of 150 $\mu g/m^3$. Therefore, according to the monitoring data, the background TSP concentration on the Dry Fork property is approximately 25 $\mu g/m^3$. Wyoming DEQ, Air Quality Division, estimates the background TSP concentration at and in the vicinity of the property to be 15 $\mu g/m^3$, 10 $\mu g/m^3$ lower than PPC's monitoring data indicate (Charles A. Collins, Wyoming Department of Environmental Quality, Air Quality Division, written communication, December 20, 1985). Windblown dust is a natural phenomenon in the Gillette area and undoubtedly contributed to the particulate concentrations PPC measured at the Dry Fork property. Present air quality at the Dry Fork property is good.

No gaseous emissions monitoring data have been collected at the Dry Fork property. During 1978-83, monitoring stations in Gillette, Wyoming, measured only very low concentrations of sulfur dioxide and nitrogen dioxide (Michael Stoll, Wyoming Department of Environmental Quality, Air Quality Division, oral communication, April 1, 1986).

B. GEOLOGY

The proposed Dry Fork life-of-mine area is located in the central part of the Eastern Powder River Basin. The overburden in the area is almost entirely part of the Eocene Wasatch Formation. Although the Wasatch Formation is dominated by claystones and siltstones, its composition is actually extremely variable, consisting

of a complex interfingering of claystone, shale, siltstone, sandstone, and minor thin limestone beds within the proposed Dry Fork life-of-mine area (plate 3).

Scoria (porcellanite) occurs extensively within the proposed Dry Fork life-of-mine area (fig. A-3) and within the other seven life-of-mine areas north and east of Gillette. Scoria is a baked and fused rock that forms above coal beds that have burned; it is hard, has a platey to slaglike texture, depending on the extent of its metamorphosis, and is red to purple. Scoria serves as an aquifer in the proposed Dry Fork life-of-mine and adjacent areas.

The coal seam PPC proposes to mine at its Dry Fork mine is the Wyodak-Anderson seam. This seam is the uppermost unit of the Tongue River Member of the Fort Union Formation. It consists of two main seams, the Anderson and the Canyon. Two thin rider seams, A_1 and A_2, are located on top of the main seam, and another thin rider seam, the Anderson Rider, occurs higher in the overburden. The total thickness of the Wyodak-Anderson seam within the proposed life-of-mine area averages 86 feet. It contains an average of 5.7 percent ash, 0.43 percent sulfur, 30.0 percent moisture, and 8,111 Btu/lb.

Approximately 304 million tons of in-place coal reserves exist within the proposed Dry Fork life-of-mine area, of which, roughly 219 million tons, or 72 percent, would be mined. This tonnage represents about 0.01 percent of the estimated 21.2 billion tons of strippable coal within the Powder River Basin.

No major faults have been found in the proposed Dry Fork life-of-mine area. However, some minor faulting and fracturing, attributable to subsidence into burn cavities, does occur within the scoria.

The overburden within the proposed Dry Fork life-of-mine area ranges from 10 to 210 feet thick and averages approximately 110 feet thick. PPC obtained core samples from 28 drill holes for the purpose of determining overburden geochemistry and reclamation suitability. Samples from 23 of these drill holes showed zones in the overburden that exceed Wyoming DEQ guideline recommendations for suitable texture and saturation percentage. Samples from eight of the holes showed zones that exceed guideline recommendations for conductivity and sodium-adsorption ratio (SAR). Samples from 15 of the holes showed zones that exceed recommendations for acid-base potential and lime. Samples from 13 drill holes showed zones that exceed recommendations for pH and nitrate nitrogen. Samples from 10 of the holes showed zones that exceed recommendations for molybdenum and lead.

The zones with geochemical parameters that exceed Wyoming DEQ, Land Quality Division, guideline No. 1 criteria often do not correlate with any particular lithology and frequently are not continuous throughout the proposed life-of-mine area. Many of these zones are relatively thin.

The companies at the other seven existing and proposed mines north and east of Gillette also conducted overburden drilling and sampling programs to identify unsuitable overburden in their respective life-of-mine areas. The intensity of individual sampling programs and the number of drill holes analyzed varied from mine to mine, ranging from a low of 15 holes at the Wyodak mine to a high of 36 holes at the Eagle Butte mine. The analyses of overburden samples, except those taken prior to the establishment of Wyoming DEQ guidelines, were conducted in accordance with Wyoming DEQ, Land Quality Division, guideline No. 1.

The sampling programs identified some overburden unsuitable for use in reclamation within all eight life-of-mine areas. The amounts of unsuitable overburden varied; however, of the eight mines, only PPC and Wyodak Resource Development Corporation estimated specific volumes of unsuitable overburden. These volumes were 19,050,000 and 55,350,000 cubic yards (yd^3) of unsuitable overburden within the proposed Dry Fork and Wyodak life-of-mine areas, respectively (Phillips Petroleum Company, 1982-86; Wyodak Resource Development Corporation, 1981-86). The reason overburden was found to be unsuitable varied from mine to mine; the majority of the unsuitable overburden either contained high SAR's or potentially acid forming materials or had unsuitable texture.

Various gases (i.e., methane, hydrogen sulfide, and hydrogen selenide) occur naturally in the Wyodak-Anderson coal seam and have been identified at various locations throughout Campbell County. Historically, these gases vented harmlessly from the coal seam into wells used for ground-water monitoring at some coal mines, but in 1987 gas seepage problems were responsible for the evacuation of residents at the Rawhide Village and Horizon subdivisions, located northwest of Gillette. Federal and State investigators have been unable to determine the exact cause of the Rawhide Village/Horizon subdivision seepage problem, but studies are continuing. Gas seepage to the surface appears to be localized; related to the closeness of the underlying coal seam (e.g., those areas with shallower overburden seem more likely to have problems). Although shallow overburden is present at the proposed Dry Fork mine, there is no physical evidence of any natural gas seepage, and problems are not anticipated. Problems are also not expected at the nearby Garner Lake subdivision (overburden in that area is approximately 200 feet deep). There have been no known reports of natural-gas seepage problems affecting any of the other private residences in Campbell County.

C. TOPOGRAPHY

The elevation within the proposed Dry Fork life-of-mine area ranges from 4,248 to 4,483 feet above mean sea level. The average elevation is 4,348 feet above mean sea level. The elevation within the other seven life-of-mine areas north and east of Gillette ranges from approximately 4,100 feet above mean sea level along the eastern boundary of the Buckskin life-of-mine area to approximately 4,640 feet above mean sea level in the center of the Clovis Point life-of-mine area (plate 2).

The topography within and surrounding the proposed Dry Fork life-of-mine area is stepped, consisting of moderately steep slopes and low cliffs. Approximately 34 percent, or 1,300 acres, of the life-of-mine area has slopes of 5 to 10 percent. Only 12 percent, or 285 acres, has slopes greater than 15 percent. These percentages reflect the dominance of very flat surfaces in the life-of-mine area, both in the uplands and in major valleys.

D. SOILS

PPC identified 48 soil mapping units in its baseline soil survey of the proposed Dry Fork life-of-mine area (Phillips Petroleum Company, 1982-86). The productivity of these mapping units varies as does the amount of topsoil they contain that is available and suitable to support vegetation on reclaimed mined areas. Eleven mapping units (table III-2) account for 3,846 acre-feet (62 percent)

of the 6,233 acre-feet of salvageable soils that would be disturbed within the entire proposed life-of-mine area. These same mapping units account for 1,050 acres (36 percent) of the total 2,905 acres that would be disturbed in the proposed life-of-mine area. Within the 11 mapping units, the amount of available suitable topsoil ranges in depth from 24 inches to 60 inches. Landscape positions of the mapping units range from ridge tops to bottomlands; textures of the mapping units range from sandy to clay loams and clays (Phillips Petroleum Company, 1982-86). Eight soil series that range widely in total annual production of native vegetation are represented in these eleven mapping units. The production of these eight soil series varies from 2,100 to 3,000 pounds of native vegetation per acre in favorable years, from 900 to 2,500 pounds per acre in median years, and from 450 to 2,000 pounds per acre in unfavorable years (Soil Conservation Service, 1977).

Table III-2.--Amount of salvageable topsoil within the 11 soil mapping units constituting the majority of soils on the proposed Dry Fork life-of-mine area

(Source: Phillips Petroleum Company, 1982-86)

Mapping unit name and percentage slope	Salvaging depth of topsoil (inches)	(feet)	Affected area (acres)	Volume of topsoil to be salvaged (acre-feet)
Haverson loam, 0- to 3-percent slopes	60	5.0	57.7	289
Olney sandy loam, 0- to 6-percent slopes	60	5.0	118.1	591
Olney-Vona, 6- to 15-percent slopes	60	5.0	89.1	446
Olney sandy loam, 0- to 6-percent slopes	60	5.0	47.3	237
Potts Variant loam, 0- to 6-percent slopes	36	3.0	78.5	236
Potts Variant Wibaux, 0- to 6-percent slopes	24	2.0	136.0	272
Stoneham fine sandy loam, 6- to 15-percent slopes	60	5.0	73.6	368
Tassel-Tullock-Vona, 6- to 30-percent slopes	48	4.0	71.8	287
ULM loam, 0- to 6-percent slopes	60	5.0	51.5	258
ULM clay loam, 0- to 6-percent slopes	36	3.0	209.9	630
ULM-Bidman, 0- to 6-percent slopes	24	2.0	116.1	232
Total			1,049.6	3,846

The number of soil mapping units within the eight life-of-mine areas north and east of Gillette varies from a low of 21 at the Clovis Point mine to a high of 48 at the proposed Dry Fork mine. Six soil series account for 21,523 acre-feet of suitable soil material (46 percent) of the total 46,650 acre-feet of suitable material available within the eight life-of-mine areas (table III-3). These six soil series range in depth from less than 20 inches to more than 60 inches. Landscape positions of these soil series range from ridgetops to bottomlands; textures of the series range from sandy to clay loams and clays. The production of these six soil series varies from 2,100 to 3,000 pounds of native vegetation per acre in favorable years, from 900 to 2,500 pounds per acre in median years, and from 450 to 2,000 pounds per acre in unfavorable years (Soil Conservation Service, 1977).

E. HYDROLOGY

All 2,905 acres that would be disturbed within the proposed Dry Fork life-of-mine area would occur within the Dry Fork Little Powder River drainage basin. These 2,905 acres represent about 27 percent of the total area (16.75 square miles (mi^2)) of the Dry Fork drainage basin. The two drainages that would be most affected by mining within the proposed Dry Fork life-of-mine area are the Dry Fork and Moyer Springs Creek, which is a tributary of the Dry Fork. The Dry Fork merges with the main stem of the Little Powder River about 3 miles downstream from the Dry Fork life-of-mine area boundary. Rawhide Creek, another significant tributary to the Little Powder River, flows into the Little Powder River about 3 miles downstream from the mouth of the Dry Fork. Plate 2 shows the location of these drainages relative to the proposed Dry Fork life-of-mine area and the life-of-mine areas of the other seven proposed and existing mines north and east of Gillette.

Average annual flows are typically estimated from gaging station data. The only gaging station with several years of data along the Little Powder River is station No. 06324970 (called the "Little Powder River above Dry Creek near Weston, Wyoming" gage), which is downstream from the Dry Fork life-of-mine area near the Wyoming State line. The average annual discharge at this station is 8,881 acre-feet per year (Phillips Petroleum Company, 1982-86). To estimate average annual flows upstream from this gage, OSMRE apportioned the average annual flows according to drainage areas. (Note, however, that estimates based on this type of apportionment, although adequate for this evaluation, do not take into account that runoff per unit area from small drainage basins is usually larger than from large drainage basins, that diversions exist throughout the basin, and that evaporation and transpiration occur along the river.) The drainage basin above the gage on the Little Powder River has a surface area of 1,235 mi^2. The average annual flow from this drainage basin is 7.2 acre-feet per mi^2 (8,881 acre-feet divided by 1,235 mi^2). Table III-4 shows the estimated flows at various points in the Little Powder River drainage. OSMRE calculated these flows by (1) multiplying the area of a given subbasin drainage listed in the table by 7.2 acre-feet per mi^2 and (2) adding the flow of Moyer Springs Creek at the confluence of Dry Fork to that figure where appropriate.

Moyer Springs Creek supports a cold water fishery and, therefore, is classified as Class II surface water. The State of Wyoming defines Class II surface waters as those streams currently supporting game fish or having the potential to support game fish (Chapter I, Section 4, Wyoming DEQ, Water Quality Division Rules and Regulations). The Dry Fork Little Powder River is classified as Class III surface water. The State of Wyoming defines Class III surface waters as those

Table III-3.--Volume of salvageable topsoil within the six soil series constituting the majority of soils on the eight life-of-mine areas north and east of Gillette

(Sources: AMAX Coal Company, 1981,-86; Carter Mining Company, 1981-86; Frontier Coal Company, 1983-85; Kerr-McGee Coal Corporation, 1981-86a, 1981-86b; Phillips Petroleum Company, 1982-86; Triton Coal Company, 1978-84; and Wyodak Resource Development Corporation, 1981-86. Data are in acre-feet)

	Mine								
Soil series	Dry Fork (proposed)	Eagle Butte	Rawhide	Buckskin	Clovis Point	East Gillette Federal (proposed)	Fort Union	Wyodak	Total
Olney	1,156	1,901	1,868	---	---	---	---	434	5,359
Shingle	163	132	535	78	87	107	315	130	1,547
Thedalund	83	570	558	12	168	---	171	343	1,905
ULM	1,027	91	---	589	128	266	1,809	---	3,910
Haverson	289	---	329	346	---	1,524	218	---	2,706
Fort Collins	450	1,277	840	128	468	---	1,986	947	6,096
Total	3,168	3,971	4,130	1,153	851	1,897	4,499	1,854	21,523

Table III-4.--Average annual flows in streams downstream of the proposed Dry Fork mine

Stream	Drainage area (mi^2)[1]	Mean annual flow (acre-feet/yr)	Basis of flow estimate
Moyer Springs Creek above Moyer Springs	2	14.4	Estimated from unit flow of 7.2 acre-feet/yr/mi^2.
Moyer Springs	---	644	Measured discharge (from permit application; Phillips Petroleum Company, 1982-86).
Moyer Springs Creek at confluence of Dry Fork	2.2	919	Measured discharge (from permit application; Phillips Petroleum Company, 1982-86).
Dry Fork above Moyer Springs Creek	8.96	64.5	Estimated from unit flow of 7.2 acre-feet/yr/mi^2.
Dry Fork above Little Powder River	16.75	1,040	Estimated from unit flow of 7.2 acre-feet/yr/mi^2 plus flow from Moyer Springs Creek.
Little Powder River above Dry Fork	25	180	Estimated from unit flow of 7.2 acre-feet/yr/mi^2.
Rawhide Creek	115	828	Estimated from unit flow of 7.2 acre-feet/yr/mi^2.
Little Powder River at confluence of Rawhide Creek	165	2,107	Estimated from unit flow of 7.2 acre-feet/yr/mi^2 plus flow from Moyer Springs Creek.
Little Powder River near Weston	1,235	8,881	Measured discharge (7.2 acre-feet/yr/mi^2; average from 7-year record).

[1]Drainage areas for these streams are from PPC (Phillips Petroluem Company, 1982-86) or Wyoming DEQ (Wyoming Department of Environmental Quality, 1985).

streams currently supporting nongame fish or having the potential to support nongame fish (Chapter I, Section 4, Wyoming DEQ, Water Quality Division Rules and Regulations).

Within and adjacent to the proposed Dry Fork life-of-mine area, ground water occurs within the alluvium, the overburden, the scoria, the coal, and the sandstone of the Fort Union Formation below the coal. The regional direction of flow in

these aquifers is to the north. Around and within the proposed Dry Fork life-of-mine area, the movement of ground water in the overburden, scoria, and coal is toward the alluvial deposits along Moyer Springs Creek and Dry Fork Little Powder River.

Alluvium in and adjacent to the proposed life-of-mine area occurs on valley floors and along small tributary channels. These alluvial deposits tend to be fine grained, reflecting the texture of the Wasatch Formation from which they have been derived. The thickest accumulations of alluvium are along the Little Powder River. Within the proposed Dry Fork life-of-mine area, alluvial deposits are of limited depth and are not a viable source of usable ground water.

The Wasatch Formation forms the overburden in the proposed Dry Fork life-of-mine area. It consists mainly of shale and interbedded lenticular sandstone (plate 3). The shale has limited permeability and retards percolation to the underlying coal. The sandstone lenses, which are the principal saturated zones, are thin, of limited areal extent, and generally not interconnected. Therefore, areal movement of ground water through the overburden is minimal.

The coal and scoria are important regional aquifers. Extensive scoria deposits occur on and adjacent to the proposed Dry Fork life-of-mine area and extend south and east through the Clovis Point, Fort Union, East Gillette Federal, and Wyodak life-of-mine areas. These deposits consist of partially burned and fused overburden of the Wasatch Formation that formed in areas overlying burning coal seams. The scoria subsequently collapsed into the burned-out cavities, leaving a highly fractured material at the same stratigraphic level as the remaining unburned coal. Where this scoria is saturated, it constitutes a high-yield aquifer.

Water yields in the coal vary in direct proportion to the coal's fracture permeability. In general, permeability in the coal is greatest along the coal outcrop, decreasing downdip (westward) (Breckenridge and others, 1974).

Water in the coal and scoria aquifers moves northward, following the regional flow pattern, through the proposed Dry Fork life-of-mine area to discharge at several points along the lower reaches of Moyer Springs Creek. Moyer Springs proper is the largest and the farthest upstream from these discharge points. The spring occurs along the terminus of scoria at the northern and eastern boundaries of the proposed life-of-mine area. Through its monitoring program, PPC has determined the average discharge of the spring to be 0.89 cubic feet per second (ft^3/s). The average flow at the mouth of Moyer Springs Creek (where the creek flows into the Dry Fork Little Powder River) is 1.27 ft^3/s.

Although coal and scoria are separate, distinct water-bearing units in the proposed life-of-mine area, they occur at the same stratigraphic level and, in places where water flows between them, act as a single, integrated aquifer. OSMRE developed a finite-difference ground-water model to predict the impact of mining on the flow of Moyer Springs and Moyer Springs Creek. For purposes of developing this model, OSMRE considered the coal and scoria to be a single aquifer. Therefore, with reference to results from model runs, OSMRE refers to the coal and scoria aquifers together as "the coal/scoria aquifer."

Total dissolved solids (TDS) concentrations measured in the coal and scoria aquifers range from 900 to 3,500 milligrams per liter (mg/L); about half the wells tapping the aquifers have TDS concentrations of less than 1,700 mg/L. The State

of Wyoming classifies ground water of this quality (i.e., TDS less than 5,000 mg/L) as suitable for livestock use (Chapter VIII, Section 4, Wyoming DEQ, Water Quality Division Rules and Regulations). PPC has measured the TDS concentration in Moyer Springs Creek at 1,200 mg/L (Phillips Petroleum Company, 1982-86).

Beneath the coal are the sandstone aquifers of the Fort Union Formation, which are known locally as the Tullock Member of the Fort Union Formation. PPC has proposed to complete a deep water-supply well in the lower sandstone of the Fort Union Formation. Water from this well would be used at the mine facilities building (20,500 gallons per day (gal/d)) and for dust control (appendix A). Thirty-seven other water-supply wells, including eight wells used by the city of Gillette, have been completed in the same zone of the Tullock Member of the Fort Union Formation, in Tps. 50, 51, and 52 N., Rs. 70, 71, 72, and 73 W., within approximately 31.5 miles of where PPC proposes to locate the Dry Fork mine water-supply well (Phillips Petroleum Company, v. 17, appendix A).

F. VEGETATION

The vegetation of the proposed Dry Fork life-of-mine area is dominated by grass species characteristic of the short-grass and mixed-grass prairies of the Great Plains. Blue grama (Bouteloua gracilis), western wheatgrass (Agropyron smithii), needle-and-thread (Stipa comata), green needlegrass (S. viridula), and prairie junegrass (Koeleria cristata) dominate that landscape. Many trees and shrub species occur sparsely throughout the area; however, big sagebrush (Artemisia tridentata) is the most common.

Bottomland, grassland, scoria/breaks, and sagebrush-grassland are the four types of vegetation communities within the proposed Dry Fork life-of-mine area (table III-5).

The bottomland type constitutes relatively flat terrain that is located primarily in the bottom of Dry Fork Little Powder River and Moyer Springs Creek drainages and, to a lesser extent, in the bottoms of smaller drainages and draws throughout the proposed life-of-mine area. The two subtypes of bottomland that occur within the proposed life-of-mine area are wet and dry bottomland. Wet bottomland is further divided into natural-flood-irrigated and subirrigated land, located primarily in the floodplain alluvium adjacent to stream channels. Dry bottomland occupies higher, drier terraces above stream channels in major drainages; it is the dominant type of land in lesser drainages and draws and supports xerophytic (dryland) vegetation. Bottomland soils are deeper and more developed than are soils in upland areas. In consequence, bottomland soils have higher water-holding capacities but lower infiltration rates than do other soils in the proposed life-of-mine area. Vegetation consists primarily of perennial grass and perennial forb species. Hydrophytic and mesophytic species associated with wetland and riparian vegetation types, respectively, are found along Moyer Springs Creek. These species may be present at some locations in the natural-flood-irrigated and subirrigated lands in the upper, intermittent stretches of Dry Fork Little Powder River, but specific information is unavailable at this time. Cattle grazing is more intense in bottomland areas, where permanent water is available, than in upland areas.

Table III-5.--Acreages and characteristics of vegetation types within the proposed Dry Fork life-of-mine area

(Source: Phillips Petroleum Company, 1982-86)

Vegetation type	Acreage		Average slope (percent)	Percentage ground cover	Productivity (lbs/acre)	Shrubs/acre
	Life-of-mine area	Area to be disturbed within life-of-mine area				
Bottomland	272.8	216.2	---	50.2	1,939.3	5,302
Grassland	1,659.5	1,209.3	5	39.2	493.8	2,944
Sagebrush-grassland	952.0	793.1	5	37.8	419.8	9,153
Scoria/breaks	698.9	593.6	20	31.4	492.8	3,469
Disturbed areas[1]	215.3	92.8				
Total	3,798.5	2,905.0				

[1]Includes miscellaneous existing disturbed areas (e.g., roads and ponds) that have little or no measurable vegetation.

The grassland type constitutes gently rolling to flat terrain with a general southeastward exposure. Grassland vegetation consists primarily of perennial grass species.

The sagebrush-grassland type is similar to grassland, particularly in average slope and aspect, but its vegetation consists more of shrubs and half-shrubs. Specifically, sagebrush-grassland vegetation consists primarily of big sagebrush and an understory of perennial grass species.

The scoria/breaks type consists of moderately steep scoria ridges and outcrops that are primarily aligned in an east-west direction. These ridges are dissected by numerous draws and small drainages. Scoria/breaks vegetation is sparse, dominated by no one plant type or species.

G. WILDLIFE

1. Brook Trout

Moyer Springs, which is located in the proposed Dry Fork life-of-mine area, has an average flow of 0.89 ft^3/sec and feeds Moyer Springs Creek. A V-notched weir below the springs has created a pool, increasing the amount of open-water habitat on the creek. The springflow is of high quality and supports the only trout population in this part of Wyoming. Riparian vegetation, but no trees, borders Moyer Springs Creek; a variety of substrate types and an abundance of aquatic vegetation exists in the creek channel.

PPC sampled Moyer Springs Creek for invertebrates and fish. Invertebrates, which are an important food source for fish, occupy a variety of niches in creeks; in consequence, they are good indicators of water and habitat quality. Diversity indices for invertebrates in Moyer Springs Creek are relatively high, indicating a healthy aquatic ecosystem. PPC collected data from Moyer Springs Creek that confirm the high quality of springflow in the creek and the good condition of its aquatic habitat. PPC collected fish species in Moyer Springs Creek, including brook trout (Salvelinus fontinalis), longnose dace (Rhinichthys cataractae), white sucker (Catostomus commersoni), and lake chub (Couesius plumbeus) (Phillips Petroleum Company, 1982-86).

The brook trout in Moyer Springs Creek were originally stocked many years ago by Wyoming Game and Fish Department (GFD). The trout are self-sustaining because the quality of water in the creek is high, food is adequate, and habitat for spawning is sufficient. The largest trout in the creek occur in its lower reaches, above the confluence with the Dry Fork Little Powder River, where large pools and cover useful to larger trout are located. However, these pools do not provide all the habitat elements necessary for continued trout survival. To survive, trout require access to all available habitats in the creek. For example, access to the riffle areas of the upper reaches of the creek is needed during the breeding season for successful reproduction. Also, riffle areas are excellent habitats for the production of invertebrates upon which brook trout depend heavily as a food source. Therefore, access to riffle areas is necessary for survival. PPC found that brook trout were most abundant in Moyer Springs Creek where pools and riffles were interspersed, at a point approximately 0.3 mile below the spring and just below the V-notched weir.

Currently, the Nature Conservancy, a private conservation organization, is considering whether to designate Moyer Springs and its associated riparian community as a special management area. Under the special management area program, the conservancy seeks to preserve representative habitats with unique or special characteristics; it sets priorities for considering areas for preservation under the program on the basis of criteria relating to the value and condition of habitats and the feasibility of managing them. The conservancy currently classifies the Moyer Springs site as Priority Rating III, meaning it has insufficient knowledge about the characteristics of the habitat. It would like to collect and evaluate site-specific field data on the Moyer Springs habitat to arrive at a better understanding of the plant and animal associations and the physical characteristics of the site (Tom Wolf, Nature Conservancy, written communication, December 12, 1985).

2. Raptors

A diverse group of raptor species inhabits the various habitats in the proposed Dry Fork life-of-mine and surrounding areas. Species documented as nesting in the general area include the great horned owl (Bubo virginianus), the prairie falcon (Falco mexicanus), the kestrel (Falco sparverius), the red-tailed hawk (Buteo jamaicensis), the Swainson's hawk (Buteo swainsoni), the golden eagle (Aquila chrysaetos), the burrowing owl (Speotyto cunicularia), and the ferruginous hawk (Buteo regalis). Other probable nesters in the general area are the rough-legged hawk (Buteo lagopus) and the marsh hawk (Circus cyaneus). These species require a variety of nest substrates, including cavities in trees, mature tree limbs, mammal burrows, and suitable spots on the ground among sagebrush plants. They prey on a variety of other species, including cottontail rabbits (Sylvilagus audubonii), mice (Peromyscus sp.), voles (Microtus sp.), songbirds, snakes, and insects.

USFWS and the operators for the six existing and two proposed mines north and east of Gillette document approximately 13 raptor pairs as nesting on and adjacent to the eight life-of-mine areas. Because some raptor nests are more easily observed than others, it is very likely that more than 13 nesting pairs are present in the area. Raptor pairs have been observed nesting on or adjacent to the proposed Dry Fork and East Gillette Federal life-of-mine areas and the existing Eagle Butte, Rawhide, Buckskin, and Wyodak life-of-mine areas; no pairs have been observed on or adjacent to either the Fort Union or the Clovis Point life-of-mine areas. Nine of the thirteen pairs are golden eagles and ferruginous hawks, which this EIS addresses in following sections. The other four pairs include a red-tailed hawk pair on the proposed Dry Fork mine; a Swainson's hawk pair on the proposed East Gillette Federal mine; and two unidentified pairs, one on the Eagle Butte mine and one on the Wyodak mine.

3. Golden Eagles

Golden eagles are protected by the Migratory Bird Treaty Act and, more specifically, by the Bald Eagle Protection Act of 1940. The Bald Eagle Protection Act specifies that a golden eagle nest may be taken during the nonnesting season if USFWS approves such taking as being compatible with the preservation of the area's nesting population. Phillips and Beske (1983) documented the density of breeding golden eagles in the entire Powder River Basin as one of the highest in the Western United States. Approximately 120 breeding pairs of golden eagles are present in the Powder River Basin; approximately 7 breeding pairs are present on and adjacent to the eight life-of-mine areas (i.e., one pair on the proposed Dry

Fork mine, two pairs on the Eagle Butte mine, one pair on the Rawhide mine, one pair on the Buckskin mine, one pair on the Wyodak mine, and one pair on the proposed East Gillette Federal mine). Golden eagles in the region nest primarily in trees, which are usually located along drainages. The home ranges of each of these seven golden eagle pairs average 20 mi^2, but this figure is dynamic and varies with the abundance of food. The primary prey of the area's golden eagles is cottontail, jackrabbits (Lepus sp.), and prairie dogs (Cynomys sp.). Prairie dogs constitute 75 percent of the prey (Phillips and Beske, 1982).

In anticipation of the development of the proposed Dry Fork mine, USFWS undertook a plan to relocate the only active golden eagle nest to be affected by that mine development. The original nest was located in sec. 25, T. 51 N., R. 72 E., sixth principal meridian, in a mature cottonwood tree along the Dry Fork Little Powder River. In 1982, through a series of moves to successive nest platforms, the nest was successfully relocated to sec. 19, T. 51 N., R. 71 W, sixth principal meridian. The pair raised young there in 1983 and 1985 (Art Anderson, U.S. Fish and Wildlife Service, oral communication, January 1986).

4. Migratory Birds Of High Federal Interest

Migratory birds of high Federal interest are species that may already be protected under the Migratory Bird Treaty Act but for various reasons are given special attention by USFWS during mineral recovery planning and development. Populations of some of these species are declining, some are vulnerable to long-term habitat changes, and some are important environmental indicators. The three species of high Federal interest addressed in this EIS are the burrowing owl, ferruginous hawk, and mountain plover (Charadrius montanus).

Burrowing owls live and nest in burrows created by mammals, such as prairie dogs and ground squirrels (Spermophilus sp.). Without active populations of such mammals, the population and distribution of burrowing owls is limited, even where food is abundant. No prairie dog towns exist on the proposed Dry Fork life-of-mine area; however, ground squirrels are present in the area, so the potential for burrowing owl nesting is high. The rate at which ground squirrels colonize reclaimed lands has not been documented, so the lag period for such lands to support burrowing owls is unknown. Identifying nests of this owl is difficult; therefore, insufficient data exist to serve as the basis for an assessment of the current population of the species in and adjacent to the eight life-of-mine areas or the Eastern Powder River Basin as a whole.

Ferruginous hawks are relatively intolerant of human disturbances and are therefore subject to a wider range of impacts from mining and reclamation activities than some of the other raptor species. Whereas ferruginous hawks prefer trees for nest sites if they are available, they also nest on the ground, on rock outcrops, and on manmade structures. When interspecific competition or the lack of suitable trees forces this species to select a ground site, it prefers rock outcrops or shrub-dominated sites. Populations of ferruginous hawks and the location of important breeding sites have not been documented for the eight life-of-mine areas or the Eastern Powder River Basin as a whole. One inactive nest, which is probably a ferruginous hawk nest, is present on the Dry Fork property. Two pairs of ferruginous hawks have been documented as nesting on or adjacent to the Eagle Butte and proposed East Gillette Federal life-of-mine areas. Because they are so open, reclaimed lands provide suitable areas for ferruginous hawks to hunt prey.

Mountain plovers are associated with open, grass-dominated habitats; this species prefers short-grass, flat, high-visibility sites for nesting. Mountain plovers are ground nesters that feed primarily on insects. Although suitable habitat for mountain plovers is present on and adjacent to the eight life-of-mine areas, bird surveys conducted by the mining companies have sighted few mountain plovers. However, this lack of sightings may not accurately reflect the area population of mountain plovers because, in general, bird surveys of this type are neither specific enough nor conducted during the correct time of the year to accurately determine the population of this species. Standard reclamation appears to restore vegetation and topography conditions that are conducive to mountain plover nesting.

5. Pronghorn

The six existing and two proposed life-of-mine areas north and east of Gillette are located within the Gillette and North Black Hills Pronghorn (Antilocapra americana) Herd units managed by Wyoming GFD in northeastern Wyoming (fig. III-1). Approximately 3,310 mi^2 of habitat within these herd units is occupied by pronghorn. In 1986, Wyoming GFD estimated the total population of these units to be 26,160 pronghorn. In the same year, Wyoming GFD's population management objectives for the two herd units totaled 19,500 pronghorn; therefore, the pronghorn population was 6,600 over the population management objectives. With the exception of a small part of the winter range, the eight life-of-mine areas comprise habitats classified as yearlong by Wyoming GFD. No critical winter range for pronghorn is present on or near the eight life-of-mine areas.

6. Mule Deer

The subject eight mines are located within the Powder River Mule Deer (Odocoileus hemionus) Herd unit managed by Wyoming GFD in northeastern Wyoming (fig. III-2). Approximately 4,300 mi^2 of habitat within this herd unit is occupied by mule deer. In 1986, Wyoming GFD estimated the population of the unit to be approximately 27,262 mule deer. In the same year, Wyoming GFD's population management objective for the herd unit was 40,000 mule deer; therefore, the mule deer population was 12,738 below the population management objective. Wyoming GFD does not consider most of the habitats within the eight life-of-mine areas to be occupied by mule deer. No critical winter range for mule deer is present in the eight life-of-mine areas. Wyoming GFD classifies some of the habitats within the life-of-mine areas as winter and yearlong. Mule deer are usually associated with areas of broken terrain; their access to suitable shrubs is essential to winter survival and maintenance.

Mule deer use of the proposed Dry Fork life-of-mine area is limited, although it appears that the number of mule deer in the area increases during the winter. Data are insufficient to confirm whether this increase is actual or only apparent. (Suitable mule deer winter habitat is present on the proposed life-of-mine area; therefore, increases in the number of deer on the area at that time could be actual, because additional deer from adjacent areas may move onto the life-of-mine area in winter. On the other hand, the deer population of the life-of-mine area could remain relatively constant year round. In this case, increases in deer population in the winter would be apparent and attributable to the fact that deer are easier to count then, when they are concentrated in herds.)

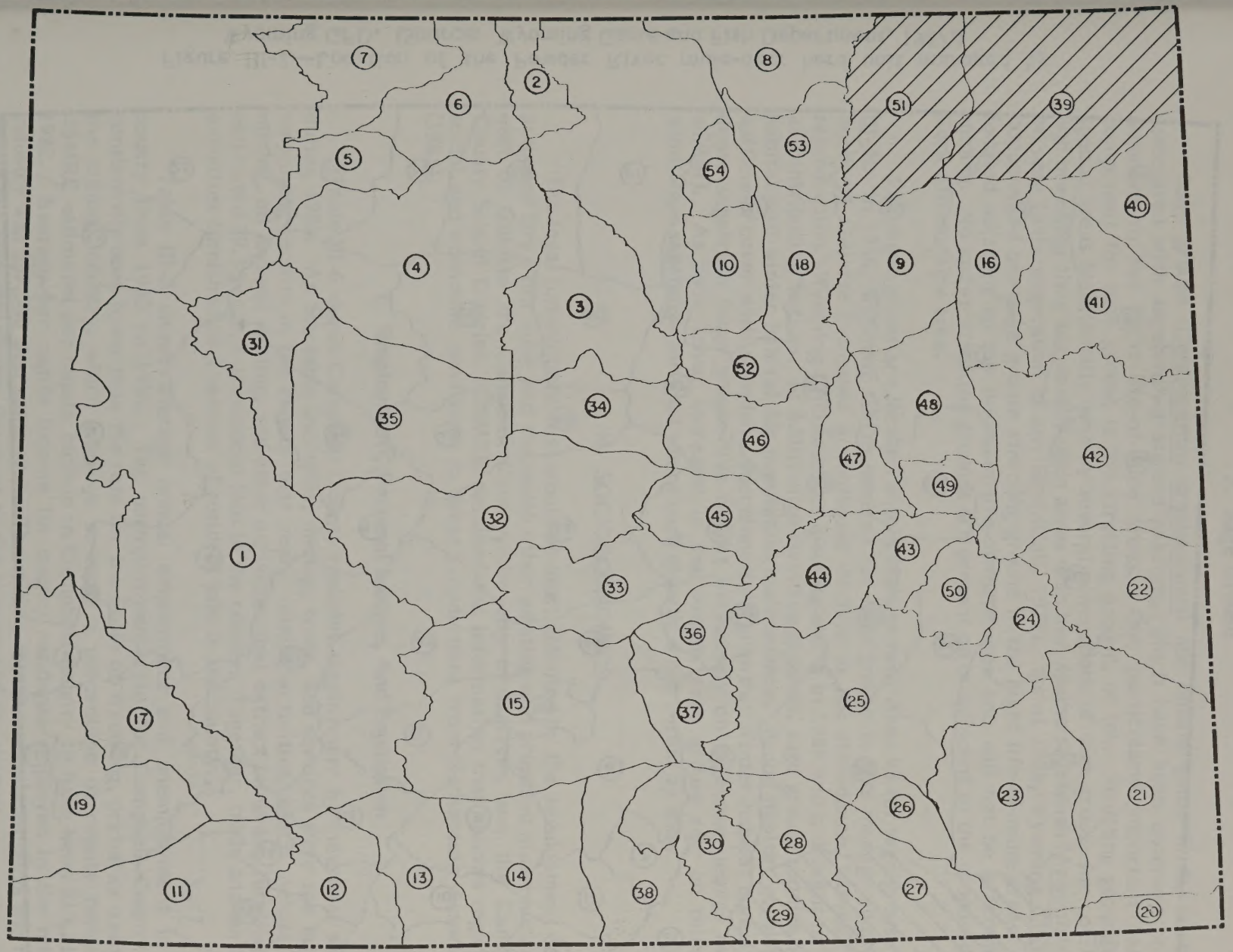

Figure III-1.--Location of the Gillette and Black Hills pronghorn herd units managed by Wyoming GFD. (Source: Wyoming Game and Fish Department, 1987.)

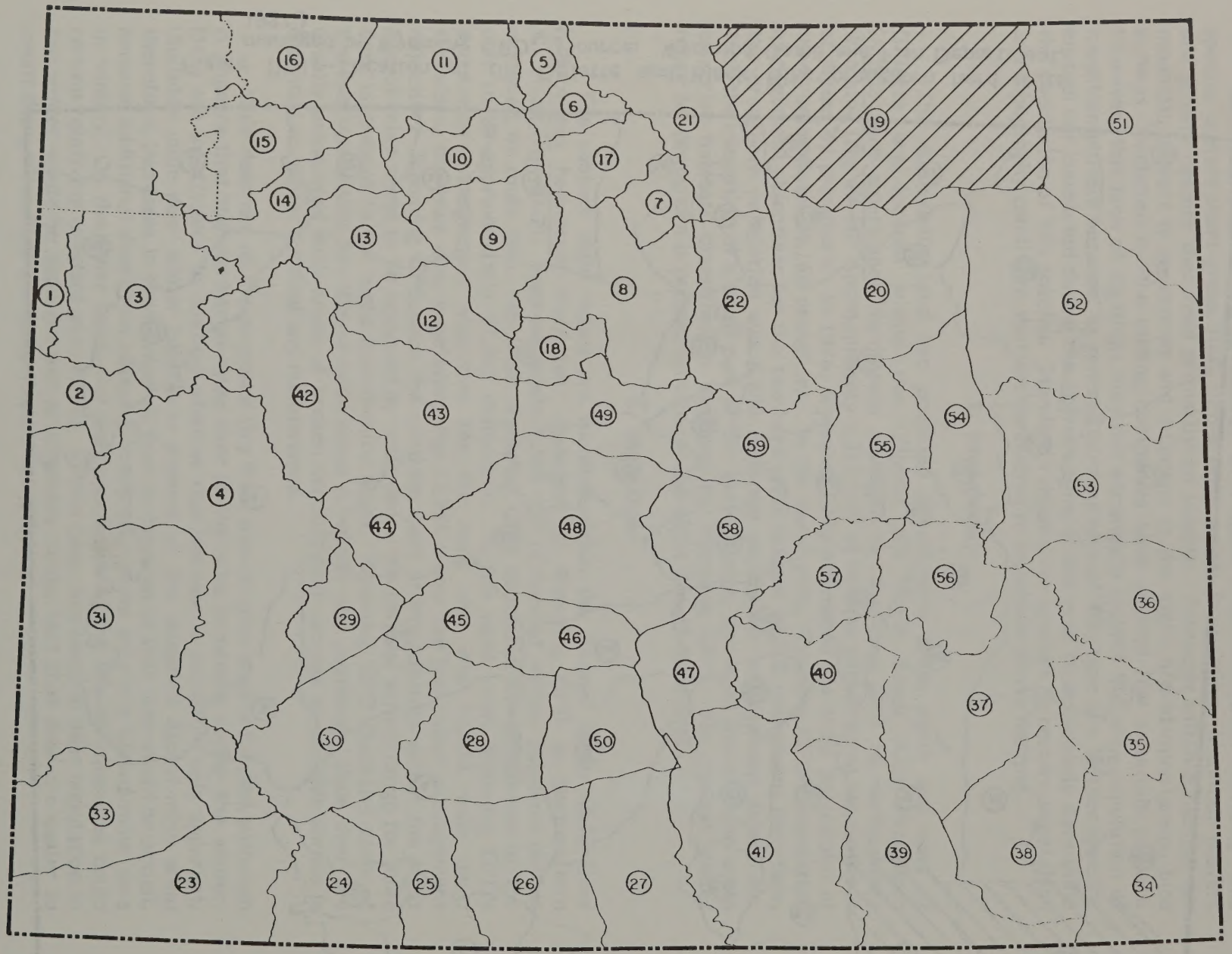

Figure III-2.--Location of the Powder River mule-deer herd unit managed by Wyoming GFD. (Source: Wyoming Game and Fish Department, 1987.)

7. Sage Grouse

Sage grouse (Centrocercus urophasianus) are upland game birds, normally associated with sagebrush-grassland habitats, which have been observed on and adjacent to the eight life-of-mine areas. One particularly important habitat component for sage grouse is the strutting ground, or lek. Strutting grounds are special areas traditionally used by several generations of sage grouse for courtship and breeding; they are usually open areas with low, sparse sagebrush (Artemisia sp.) or very little vegetation of any kind (Call, 1979). As of 1984, Wyoming GFD had documented one sage grouse strutting ground in the eight life-of-mine areas. It is located adjacent to the Buckskin life-of-mine area and will not be affected by mining. No known strutting grounds are present on or adjacent to the proposed Dry Fork life-of-mine area.

The eight mines are located within Management Area 43 for sage grouse (fig. III-3). In 1986, Wyoming GFD's analysis for sage grouse in this management area north of Gillette indicated a continued decline in lek attendance, harvest, and reproduction. Wyoming GFD suspects a spring storm in 1984 and a drought in 1985 as contributing factors. In addition to strutting grounds, sage grouse require brood habitat and winter habitat for population maintenance. Brood habitat consists of sufficient cover with abundant, succulent forb growth. Winter habitat consists of dense sagebrush (sage grouse live almost exclusively on sagebrush leaves in the winter). As snow cover increases in the winter, sage grouse rely on taller or windswept sagebrush for food where such growth is not buried by snow.

H. SOCIOECONOMICS

The legal jurisdictions that would be most affected by the development of the proposed Dry Fork mine and the seven other existing and proposed mines north and east of Gillette are Campbell County, the city of Gillette, and the Campbell County School District. OSMRE obtained the information that follows regarding social and economic conditions in these jurisdictions from Richardson Associates (1985).

1. Employment, Personal Income, And Population

Table III-6 shows Campbell County resident employment by industrial sector during 1984. As the table indicates, mining, trade, and services were the largest employing sectors in the county that year. Mining activities, which include coal mining, oil and gas drilling, and other activities that extract minerals, furnished an estimated 29.3 percent of resident jobs in the county. Together, trade and services activities furnished 36.6 percent of resident jobs in the county.

Table III-7 shows average annual employment and unemployment in the county from 1980 to 1984. The unemployment rate for Campbell County has consistently been lower than the rate for the State of Wyoming, primarily owing to the mining industry, which employs so large a percentage of county residents. OSMRE estimates per capita income in Campbell County to have been $13,214 in 1982. Average per capita income for county residents employed in the mining industry was $37,000 that same year. The mining sector not only employs the most people but also contributes the most to the economy of the county.

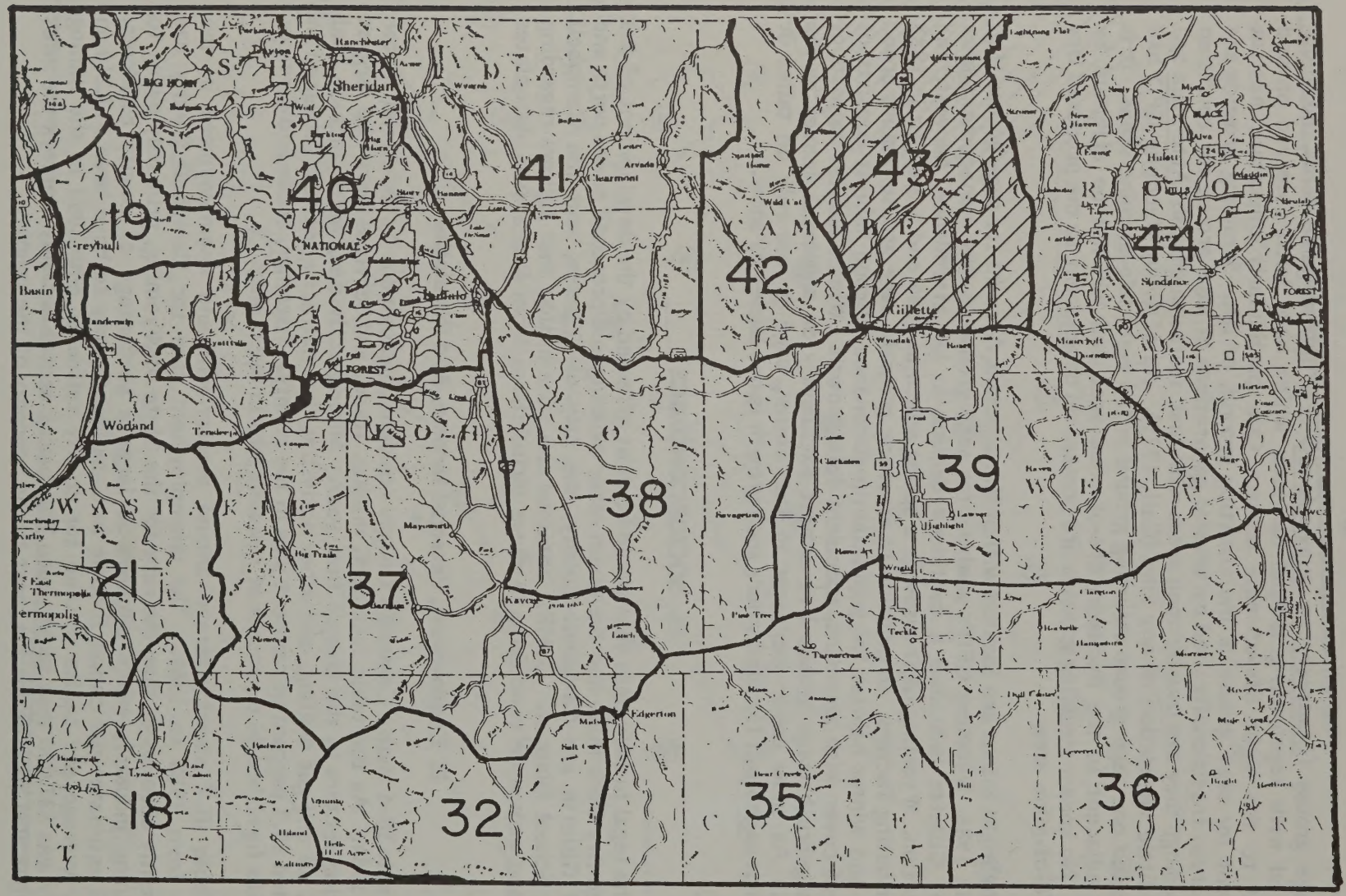

Figure III-3.--Location of Wyoming GFD Management Area 43 for sage grouse.
(Source: Wyoming Game and Fish Department, 1987.)

Table III-6.--Campbell County resident employment by industry, 1984

(Source: Richardson Associates, 1985)

Industrial sector	Number of employees	Percentage of total
Mining:		
Coal	2,587	15.2
Oil and gas	2,396	14.0
Other	13	0.1
Mining subtotal	4,996	29.3
Construction	1,726	10.1
Manufacturing	165	1.0
Transportation, communications, and utilities	1,323	7.9
Trade	2,894	16.9
Finance, insurance, and real estate	400	2.3
Services	3,179	18.6
Public administration	700	4.1
Agriculture	650	3.8
Nonfarm proprietors	1,045	6.1
Total	17,077	100.0

Table III-7.--Campbell County average annual employment and unemployment, 1980-84

(Source: Richardson Associates, 1985)

	1980	1981	1982	1983	1984
Employment	13,949	17,523	19,474	18,403	18,056
Unemployment	481	573	922	1,429	1,042
Total labor force	14,430	18,096	20,395	19,833	19,098
Unemployment rate (percent)	3.3	3.2	4.5	7.2	5.5

Table III-8 shows population estimates for Gillette and Campbell County during 1970 and 1980 through 1984. In 1984, 34,830 persons resided in Campbell County, of whom 58 percent (20,250 persons) resided in the city of Gillette proper and an additional 21 percent (more than 7,000 persons) resided in the Gillette urban area. The remaining 21 percent of Campbell County residents (more than 7,000 persons) was dispersed in various locations either throughout rural parts of the county (16 percent) or in the town of Wright (5 percent).

The number of in-migrants into the county decreased between 1980 and 1984. In general, the population stabilized as a result of the slowdown in employment opportunities and a transition from a large construction workforce in 1980 to a operation workforce in 1984.

No persons live on the Dry Fork property. The nearest residential area to the property is the Garner Lake housing development, which is approximately 1 mile northeast of Gillette's city limits and approximately 2 miles south of the Dry Fork property.

Table III-8.--Estimated population and annual growth rates in Gillette and Campbell County during selected years

(Source: Richardson Associates, 1985)

	Gillette		Campbell County	
Year	Number of persons	Annual growth rate (percent)[1]	Number of persons	Annual growth rate (percent)[1]
1970	7,194		12,957	
		6.5		7.8
1980	13,500		27,500	
		11.1		14.2
1981	15,000		31,400	
		18.0		6.0
1992	17,700		33,300	
		0		1.3
1983	17,700		33,720	
		14.4		3.3
1984	20,250		34,830	

[1]Annual growth rate percentage figures in this table describe the rate of growth in population over the period defined in the "year" columns of the table. Thus, from 1970 to 1980, the population of Gillette increased 6.5 percent per year.

2. Public Water Supply And Wastewater Treatment

The Gillette water-supply system is managed as a public utility and is operated by the Department of Public Works. As of the end of 1984, water for Gillette was partially furnished by eight wells tapping the Fort Union Formation. Gillette stored the water from these and other wells in three storage tanks that had a combined capacity of 6 million gallons. A 7-million-gallon water reservoir constructed in southwest Gillette became operational in mid-1985. Average daily water demand in Gillette in 1984 was 2.8 million gallons per day (gal/d); peak demand was 6.7 million gal/d. Sufficient water should be available from currently developed sources to meet the city's demand.

Sewage is collected within the city limits of Gillette by means of a centralized system that is generally in good condition. None of the system's major lines should need to be replaced.

Gillette's sewage treatment plant, built in 1974, uses a gravity-fed, activated sludge system to process approximately 3.3 million gal/d of sewage. Between 1981 and 1986, the quality of effluent discharged from this plant was generally not within State permit requirements because in 1981 the population of the city grew beyond 14,000, the number of persons the plant was constructed to serve. In 1983, Gillette obtained grant monies to expand the plant's capacity so that it could process an additional 3.0 million gal/d of sewage. Gillette completed this expansion in mid-1985. Gillette completed a project to upgrade the current waste handling method in the expanded plant in 1986.

3. Law Enforcement And Fire Protection

Police protection within the city of Gillette is provided by the Gillette Police Department, which operated in 1985 with a staff of 51 persons. The new Gillette City Hall, completed in 1984, houses law enforcement facilities, which include a jail with capacity for 20 inmates. Existing facilities and staffing should be adequate to meet demand.

Law enforcement in unincorporated Campbell County falls under the jurisdiction of the Campbell County Sheriff's Department, which operated in 1985 with a staff of 72 persons. Campbell County completed construction of a new jail facility in 1985. Existing facilities and staffing should be adequate to meet demand.

Gillette and Campbell County operate and fund a joint volunteer fire department through the Joint Powers Board. The department, which operated in 1985 with a staff of 80 persons, is headquartered within Gillette's city limits, where 3 of the 11 pumpers owned by the department are stationed. Ten additional substations are operated in the Gillette area. Existing facilities and the number of volunteer firemen should be adequate to meet demand.

4. Housing

Campbell County contained an estimated 13,081 housing units as of December 1985. Approximately 79 percent of these units were located in the Gillette urban area, which includes the city of Gillette.

As of the end of 1984, the county contained an estimated 1,059 vacant units and mobile-home spaces, which together constituted 8.1 percent of the total housing available in the county. (The county also contained an unknown number of undeveloped subdivision lots additional to these vacant units and spaces.) Nearly 36 percent of the vacant units were located in the city of Gillette; another 33 percent were located throughout the remainder of the Gillette urban area.

The Garner Lake housing development contains mainly single-family units and mobile homes, but also a few commercial buildings. The physical condition of housing in the development ranges from fair to poor; the condition of housing may continue to deteriorate as population in the county continues to move away from the development to areas south and southeast of Gillette.

5. Educational Facilities

Campbell County school enrollment in the late 1970's and early 1980's grew at an average annual rate of 7.3 percent. Total enrollment in 1984 was 7,664 students. During 1984, the Campbell County School District was operating 1 high school, 1 combined junior/senior high school, 2 junior high schools, 10 rural elementary schools, and 8 elementary schools within Gillette's city limits. Enrollment was slightly greater than capacity in three of the elementary schools but was below capacity in all the other schools. Overall, total enrollment was approximately 20 percent below the enrollment capacity of the entire school system. The district employed 537 teachers, or 1 teacher per 16.4 students, in 1984. Existing facilities and staffing should be adequate to meet demand.

6. Human Services And Health Care Facilities And Services

Campbell County welfare and social services are administered through the Campbell County Field Office of the Wyoming Department of Public Assistance and Social Services. The number of workers at the coal mines, as well as the transiency associated with large numbers of construction workers, was substantially less in 1984 than in 1980.

Other medical and human service facilites in Campbell County include the Pioneer Manor Nursing Home, the Northern Wyoming Mental Health Center, and the Powder River Alcohol and Drug Abuse Center. Although these facilites should be adequate, they may be understaffed. In general, staffing for human services has not been adequate to meet demand in the county.

7. Public Sector Fiscal Conditions

The major source of Campbell County revenue is property taxes, which constituted approximately 65 percent of total revenues in fiscal year 1984-85. Other sources of revenue are sales and use taxes, gasoline taxes, miscellaneous fees, taxes and licenses, grants, loans, and payments in lieu of taxes. The county's largest expenditure in fiscal year 1983-84 was to construct, repair, and maintain roads and bridges (25 percent of total expenditures). The county also spent money that year on bond and interest payments (15 percent), law enforcement (15 percent), general government (12 percent), the county airport (11 percent), and health care, the judiciary, recreation and library facilites, and miscellaneous (22 percent). County expenditures increased steadily through the 1970's and up to the present; they totaled an estimated $49.1 million in fiscal year 1984-85. The county

had a remaining borrowing capacity of over $20 million at the beginning of the 1984-85 fiscal year.

Revenues accrue to the city of Gillette primarily from enterprise funds (charges to users for sanitation, water, sewer, and power), the capital project fund (optional sales tax, the Madison Water Project, and wastewater plant grants), and sales and use taxes. General fund expenditures are used primarily for governmental operating costs rather than for capital improvements. City revenues and expenditures dropped slightly from their peak of nearly $7.5 million in fiscal year 1982-83 to approximately $6.7 million in fiscal year 1984-85.

The largest revenue source for the Campbell County School District is property taxes. Revenues from the county have been altered by changes in the State education financing program. Over $9 million of locally generated revenues were transferred to the State in fiscal year 1983-84; approximately $10.4 million were transferred in fiscal year 1984-85. Operating expenditures decreased from $55.6 million in fiscal year 1982-83 to $48 million in fiscal year 1984-85. As of fiscal year 1984-85, the district had an outstanding general obligation debt of $12 million and a remaining legal debt capacity of over $142 million.

8. Social Well-Being

From the late 1970's to 1985, what began as considerable employment opportunities and high population growth rates in and around Gillette declined. As a result, a more stable working and living environment was created. The 1984 workforce consisted of more current residents of the area than had the 1980 workforce because fewer in-migrants were seeking work in Gillette in 1984. Turnover and absenteeism rates at the coal mines, as well as the transiency associated with large numbers of construction workers, were substantially less in 1984 than in 1980.

According to a 1984 citizen survey conducted by the Gillette Planning Department, most residents felt the quality of life in Gillette to be acceptable and improving. They also closely associated their ability to find and keep employment with their quality of life. Residents recognized the importance of energy development to their region's economy and rated both the local economy and unemployment as the most important issues in 1983 and 1984. Citizen surveys conducted after 1976 but prior to 1984 show that citizens had become less concerned with growth management (e.g., adequate facilities and services) and environmental protection (e.g., water quality and esthetics) and more concerned with economic issues. Because major growth in the region has been relatively recent, the recession that began in 1982 and 1983 was the first major economic shock experienced by most residents of Gillette. Efforts to continue economic stabilization and diversification are likely to be high priorities in coming years as the future of energy development remains uncertain.

I. RECREATION

The Campbell County Department of Parks and Recreation is funded by means of a general fund and of other revenue sources; this department is responsible for administering parks in Campbell County. The county updated and revised its master plan for parks in 1984 to provide for 11 neighborhood parks and 6 community parks, including ball parks, tennis courts, playgrounds, picnic areas, and

open space outside Gillette. The county controls about 497 acres of parkland, 200 acres of which has been developed. The department also maintains the Campbell County Recreation Center within the Gillette city limits.

The Gillette Parks Department is responsible for maintaining and developing neighborhood and community parklands within and around the city. As of 1984, the department had developed parks on 166 of the total 468 acres it controlled.

The Wyoming Recreation Commission manages Keyhole State Park. The 6,256 land acres and 9,418 water acres in the park were used by 145,017 visitors in 1984 for camping, fishing, powerboating, and waterskiing. A visitors' center is located at the headquarter's complex and seven "semiprimitive" campgrounds have been developed. Most camping is scattered throughout the park in undeveloped, "primitive" campsites. State-sponsored use surveys during the 1984 season found that 80.3 percent of all park visitors were from the State of Wyoming; 50.3 percent of these visitors traveled to the park from Gillette and Campbell County, approximately 45 miles to the west. The State predicts that the number of visitors at Keyhole State Park will continue to increase to possibly as many as 180,000 persons by the year 2000 (Joe Bonds, Wyoming Recreation Commission, oral communication, July 27, 1987).

J. TRANSPORTATION

The State of Wyoming maintains the major traffic routes through Campbell County--over 400 miles of paved highway. The majority of this highway system consists of two-lane roads. Interstate 90, 3 miles of Wyoming 59, south of Gillette, U.S. 14/16, east and north of Gillette, and Warlow Drive in the city of Gillette are four-lane roads. Campbell County's Road and Bridge Department maintains roads under the county's jurisdiction; this department has 60 full-time employees. The Gillette Public Works Department maintains Gillette's streets; this department has 15 full-time and 5 part-time employees.

Garner Lake Road is the main access road to the Fort Union and Clovis Point mines and to the proposed Dry Fork and East Gillette Federal mines. It is a paved, two-lane (county) road for approximately 6 miles north of its junction with State Highway 41.

The Burlington-Northern Railroad main line, which runs east and westbound through Gillette, carried 17 unit trains per day through the city in 1984. Coal is shipped to 60 powerplants in 20 States over this railline. The Orin-Gillette line, which is a 116-mile track that runs between Donkey Creek Junction, 5 miles east of Gillette, and Orin Junction, near Douglas, transports coal from mines in the southern and central part of Campbell County to existing main lines in Gillette and Douglas. Burlington-Northern handles coal originating along the northern part of this railline. A Burlington-Northern branchline currently services the Buckskin, Rawhide, Eagle Butte, Fort Union, and Clovis Point mines and would service the proposed Dry Fork and East Gillette Federal mines.

K. CULTURAL RESOURCES

The Powder River Basin, including eight mines north and east of Gillette, appears to have been occupied by hunting and gathering peoples for at least 11,000

years. Archeologists theorize that population density gradually increased through time until around A.D. 200, when the population began to expand dramatically. However, with the establishment of formal reservations outside the area during the 1860's, Indian occupation of the Powder River Basin suddenly came to an end.

An intensive cultural resource inventory was conducted in 1981 that covered a 4,065-acre study area, including the Dry Fork mine permit area and a surrounding buffer zone (Greiser and others, 1982). Fieldwork, site recording, data analysis, and site evaluation techniques associated with the inventory and the resulting report meet or exceed current professional standards.

The 1981 survey recorded 16 prehistoric sites that included open and stone-circle campsites (tipi rings), lithic workshops, and an unidentified alignment of dry laid stones. Three of these prehistoric sites were originally considered eligible for listing in the National Register of Historic Places because they were thought to have the potential for yielding important information regarding patterned activities in prehistoric campsites as well as settlement and subsistence patterns in the Eastern Powder River Basin. One of the sites, an enigmatic stone configuration, was further evaluated in 1982 by a team of archeologists representing OSMRE, Wyoming DEQ, and the Wyoming State Historic Preservation Office (SHPO). In their judgment, the feature is not prehistoric in age, likely represents a recently constructed shepherd's or hunter's windbreak, and is not significant. Both remaining eligible prehistoric sites will be impacted by proposed mining operations at the Dry Fork mine. The area in and around Moyer Springs Creek is a prime location for buried deposits, but no deposits have been found up to this time.

Nine historic sites were recorded during the 1981 survey, but only one--the Moyer Homestead located north of the Dry Fork mine permit area in the buffer zone, is considered to be eligible for listing in the National Register of Historic Places. The Moyer home and associated wooden buildings, dating from the early 20th century, are good examples of those found on medium-sized ranches during that period. The only other standing historic structure that was inventoried is located within the Dry Fork mine permit area; it is the remains of what appears to be a cattle shelter built sometime after 1950. This shelter has no historic significance. Of the remaining seven sites, four consist of stone foundations and depressions that suggest temporary habitation and three are amorphous trash deposits lacking significance.

A majority of the known cultural resource sites in this part of the Powder River Basin have been recorded as a result of studies conducted in relation to the existing and proposed coal mines in the basin. Table III-9 shows the number of historic and prehistoric sites located on and adjacent to the life-of-mine areas of the eight mines north and east of Gillette. A majority of the prehistoric sites are lithic scatters or workshops of limited artifactual and areal extent, representing short periods of use. Of the recorded prehistoric sites, approximately 15 percent were recommended as being eligible for inclusion in the National Register of Historic Places and as deserving of additional protection (mitigation) from impacts, but only 6 percent of the historic sites were considered eligible. The historic sites range from limited trash dumps and isolated foundations to currently operating ranches that have developed from the early homesteading period in this part of Wyoming.

L. LAND USE

1. Oil And Gas

Integrity Oil & Gas Company owns and operates three active oil wells within the area that would be mined during the life of the proposed Dry Fork mine. These three wells are the Keck No. 1, in the SE¼NE¼ sec. 26, T. 51 N., R. 72 W., sixth principal meridian; the Mattie No. 1, in the SE¼SE¼ sec. 26, T. 51 N., R. 72 W., sixth principal meridian; and the Sawyer State No. 2, in the SE¼SE¼ sec. 36, T. 51 N., R. 72 W., sixth principal meridian.

PPC (Phillips Petroleum Company, 1982-86) owns two oil pipelines that cross areas that would be mined. The first of these crosses the S½SW¼ sec. 29 and the E½E½ sec. 30, T. 51 N., R. 71 W., sixth principal meridian; the second crosses the W½W½ sec. 25, the E½E½ sec. 26, the NE¼NE¼ and SW¼SE¼ sec. 35, and the SE¼ sec. 36, T. 51 N., R. 72 W., sixth principal meridian.

Big Horn Fractionation Company owns a gas pipeline that crosses an area that would be mined in the S½S½ sec. 30 and the N½NW¼ sec. 32, T. 51 N., R. 71 W., sixth principal meridian.

2. Public Utilities

Mountain States Telephone & Telegraph Company owns a telephone line that crosses several areas that would be mined by PPC. Specifically, the line crosses the SE¼ sec. 23 and the S½S½ sec. 24, T. 51 N., R. 72 W., sixth principal meridian, as well as the W½SW¼ sec. 19, the NW¼ sec. 29, the N½N½ sec. 30, the N½NE¼ sec. 31, and the N½NW¼ sec. 32, T. 51 N., R. 71 W., sixth principal meridian.

Tri-County Electric Association, Inc., owns an electric powerline that crosses areas that would be mined in the E½NE¼ and W½SW¼ sec. 31, T. 51 N., R. 71 W., sixth principal meridian, as well as the NE¼NE¼ sec. 35, and the NW¼, NE¼SW¼, and SE¼ sec. 36, T. 51 N., R. 72 W., sixth principal meridian.

3. Livestock Grazing

Currently, the entire proposed Dry Fork life-of-mine area is used to graze livestock. Joseph R. and Dorothy A. Kawulok graze primarily cattle on a single approximate 40-acre plot, which they have leased from Kerr-McGee Coal Corporation, in sec. 6, T. 50 N., R. 71 W., sixth principal meridian. Don Hockett grazes horses on a single approximate 100-acre plot, which he has leased from Meadowlark Farms, in secs. 26 and 35, T. 51 N., R. 72 W., sixth principal meridian. Betty Marie and Joseph L. Marshall graze primarily cattle on the remainder of the proposed life-of-mine area; they lease these lands on an annually renewable basis from PPC and the State of Wyoming.

4. Other

The portion of the Burlington-Northern Railroad Company north-south branch railroad line that services the Rawhide, Eagle Butte, and Buckskin mines and that would eventually service the proposed Dry Fork mine crosses the proposed life-of-mine area in the SE¼SE¼ and SW¼ sec. 19, the NW¼ sec. 29, and the NE¼NE¼ sec. 30, T. 51 N., R. 71 W., sixth principal meridian, as well as in the NE¼SE¼ sec. 24, T. 51 N., R. 72 W., sixth principal meridian.

Table III-9.--Currently known historic and prehistoric cultural-resource sites on and adjacent to the eight proposed and existing life-of-mine areas north and east of Gillette, Wyoming

(Sources: AMAX Coal Company, 1981-86; Carter Mining Company, 1981-86; Frontier Coal Company, 1983-85; Kerr-McGee Coal Corporation, 1981-86a, b; Phillips Petroleum Company, 1982-86; Triton Coal Company, 1978-84; and Wyodak Resource Development Corporation, 1981-86)

Life-of-mine area	Number of historic sites	Number of prehistoric sites	Total
Buckskin	2	9	11
Clovis Point	([1])	([1])	([1])
Dry Fork (proposed)	9	16	25
Eagle Butte	6	22	28
East Gillette Federal (proposed)	1	9	10
Fort Union	10	19	29
Rawhide	20	80	100
Wyodak	4	13	17
Total	52	168	220

[1]This table includes the number of known cultural resource sites on and adjacent to the Clovis Point life-of-mine area as part of the total number of sites on and adjacent to the proposed East Gillette Federal life-of-mine area.

Black Hills Power and Light Company operates two power generation plants (the Neil Simpson Station and the Wyodak No. 1 Station, generating 20 and 330 megawatts, respectively) adjacent to the Wyodak mine in the W½NW¼ sec. 27, T. 50 N., R. 71 W., sixth principal meridian.

M. VISUAL RESOURCES

No visual-range (visibility) measurements have been made in the proposed Dry Fork life-of-mine area. However, visibility-monitoring data (from a nephelometer) have been collected during a 2½-month period (November 1981 through January 1982) at the Hampshire Energy site (SW¼NW¼ sec. 8, T. 48 N., R.

70 W.), approximately 13 miles southeast of Gillette, Wyoming. OSMRE considers these data to be representative of visual-range conditions in the proposed Dry Fork life-of-mine area.

Hampshire Energy site data show the mean visual range in the Gillette area to be approximately 112 miles, with a lower bound of 93 miles and an upper bound of 140 miles (Latimer and Maxwell, 1982). Most of the variation from upper to lower bound is attributable to natural occurrences, including variations in relative humidity resulting from passage of weather systems, windblown dust, precipitation, and fog. Pollution related to human activities also reduces visual range in the Gillette area. The amount of such reduction varies according to the amount of pollution from far-distant developed areas that is transported to the Gillette area by weather systems and to the amount of emissions from the Gillette area itself. In general, visual range is greatest during the summer and least during the winter in the Gillette area. Present visual range in the proposed Dry Fork life-of-mine area is good.

OSMRE is aware of no site-specific visual range data for Devils Tower National Monument, which is approximately 44 miles east-northeast of the proposed Dry Fork mine. The monument is the closest potentially sensitive air quality area to the eight proposed and existing mines north and east of Gillette. Background visual range at the monument would be at least as good as that in the Gillette area (i.e., at least 112 miles).

CHAPTER IV

ENVIRONMENTAL CONSEQUENCES

This chapter contains OSMRE's analysis of the probable impacts to the quality of the human environment that would result from surface coal mining operations at the proposed Dry Fork mine. It also contains the analysis of probable cumulative impacts that would result from adding the proposed Dry Fork mining operation to the surface coal mining operations at the other six existing mines (Eagle Butte, Rawhide, Fort Union, Clovis Point, Buckskin, and Wyodak) and one proposed mine (East Gillette Federal) currently operating or proposed for operation north and east of Gillette, Wyoming.

A. ASSUMPTIONS OF THE IMPACT ANALYSIS

In order to perform the impact analysis contained in this chapter, certain assumptions concerning the proposed Federal action were necessary. The following assumptions are for the purpose of this analysis only and are not intended to be the final word on future activities that may or may not materialize in the area over the next 34 years.

1. Assumptions of Alternatives 1 and 2

The assumptions OSMRE made to perform the impact analyses under alternatives 1 and 2 are--

- The PAP submitted by PPC for the Dry Fork mine, with Wyoming DEQ conditions attached, is in compliance with SMCRA.
- Mining and reclamation technology will not change substantially through the end of mine life.
- Labor, equipment, and/or market shortages/surpluses will not materially change the projected levels of development.
- Although reclamation will be an ongoing process to be initiated when an area is no longer needed for either mining or production operations, none of the disturbed acres will actually be available for postmining land use until the end of mine life.
- Impacts to coal supply or demand (regional or otherwise) are beyond the scope of this EIS.
- The life of the proposed Dry Fork mine will be 34 years: 2 years for premining development, 22 years for active mining and reclamation, and a minimum of 10 additional years for bond release after seeding, fertilizing, irrigation, or other work to ensure revegetation is complete. The lives of the other seven mines in the analysis will be as specified in appendix B.

- The local short-term impacts of the proposed Dry Fork project are those that occur during the 34-year period from premining development through the end of mine life (i.e., bond release after successful reclamation). Long-term impacts of the project are those which persist beyond the end of mine life. With reference to the other seven mines in the analysis, the short-term impacts are those which occur during the lives of the respective mines and the long-term impacts are those which persist beyond the number of years indicated in appendix B to be the lives of these mines.

- An irreversible and irretrievable commitment of resources will occur when various resources are either consumed, committed, or lost during the life of the project. The commitment of a resource will be "irreversible" when the productivity of that resource (current and/or potential) is lost and, once lost, can never be regained (i.e., the loss of this productivity cannot be "reversed"). The commitment of a resource will be "irretrievable" when the productivity of that resource (current and/or potential) is lost for the life of the proposal but can be regained at some future time (i.e., the loss of this productivity can be "reversed").

- Qualitative terms are used to describe the anticipated magnitude of impacts and, where appropriate, the anticipated importance of the impact to the human environment. Terms such as "major," "moderate," "minor," "negligible," and "no impact" describe magnitude, whereas "significant," "potential to become significant," and "insignificant" describe importance. Impacts are assumed to be insignificant unless identified otherwise.

- Cumulative environmental impacts are those which result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). This EIS addresses cumulative impacts as the incremental impacts that would result from mining and mining-related activities at the proposed Dry Fork mine when added to the impacts that would result from either mining and mining-related activities at the other seven existing and proposed surface coal mines north and east of Gillette or any other pertinent activity in the immediate area. (See the discussion of geographical limits below.)

- The geographical limits for the analysis of probable impacts in this EIS primarily encompass the life-of-mine areas for the eight existing or proposed mines located north and east of Gillette, Wyoming. For several resources, larger geographical limits were established to allow for the required analysis and assessment of all impacts:

  Air quality.--The eight life-of-mine areas and their vicinity, including the city of Gillette.

  Hydrology.--An approximate 323 mi^2 area (about 17 miles wide east to west and 19 miles wide north to south), the corners of which are located in NW¼ sec. 15, T. 49 N., R. 71 W.; NE¼, sec. 14, T. 49 N.,

R. 74 W.; and SE¼, sec. 11, T. 52 N., R. 74 W. (See figure I-2, appendix D.) The northeast quarter of this area has an irregular boundary that approximately follows the Little Powder River. The south and east boundaries of the area are located about 4.5 and 6 miles from Gillette, respectively.

Wildlife.--Generally, the eight life-of-mine areas and a 2-mile-wide buffer zone around them. For pronghorn, mule deer, and sage grouse, the geographical limits for the analysis would be the Gillette and North Hills Herd units (fig. III-6), the Powder River Herd unit (fig. III-7), and Management Area 43 (fig. III-8), respectively.

Socioeconomics.--The eight life-of-mine areas and their vicinity, including Campbell County, the city of Gillette, and the Campbell County School District.

Recreation.--The eight life-of-mine areas and their vicinity, including Campbell County, the city of Gillette, and Keyhole State Park, which is approximately 45 miles east of Gillette.

Transportation.--The eight life-of-mine areas and their vicinity.

Land use.--Generally, the eight life-of-mine areas and their vicinity and the 7-mile reach of Dry Fork Little Powder River from its confluence with Moyer Springs Creek to the confluence of the Little Powder River with Rawhide Creek.

Visual resources.--The eight life-of-mine areas and their vicinity, including the city of Gillette and Devils Tower National Monument, which is approximately 44 miles east-northeast of Gillette.

- The employment assumptions for the economic analysis would be as shown in table IV-1.

- The fiscal assumptions for the economic analysis would be as shown in table IV-2.

2. Assumptions of the Disapproval Alternative

The assumptions OSMRE made to perform the impact analyses under the disapproval alternative are--

- Under this alternative, resources currently existing in the area of the proposed Dry Fork mine would not be disrupted by activity related to coal mining, but they would be subject to the continuing processes of nature and man. To accurately evaluate the impacts of the proposed Dry Fork mine on these resources, analysis of impacts under this alternative will examine the effects of current management and natural processes on the existing resources through the year 2022, the year assumed for final bond release of the Dry Fork mine (1988 plus 34 years).

Table IV-1.--Employment assumptions upon which OSMRE based its economic analyses

(Source: Richardson Associates, 1985[1])

Employment parameter, Campbell County	Assumption[2]
Basic employment, oil and gas industry	Constant at 2,100 employees through the year 2015.
Basic employment, other industrial sectors	Stable in accordance with historical growth patterns.
Labor force participation rate	52 percent of persons eligible for employment actually employed in 1984 and 1985; 51 percent actually employed thereafter.
Workers per household	1.460 persons through the year 2015.
Persons per household	3.008 persons in 1984; 0.006 fewer persons per year thereafter.

[1]Richardson Associates' sources of information were AMAX Coal Company, 1981-86; Carter Mining Company, 1981-86; Frontier Coal Company, 1983-85; Kerr-McGee Coal Corporation, 1981-86a and 1981-86b; Phillips Petroleum Company, 1982-86; Triton Coal Company, 1978-84; Wyodak Resource Development Corporation; 1981-86; and Wyoming Department of Economic Planning and Development, 1985.

[2]These assumptions support a worst case scenario and may not reflect actual conditions at the time this EIS is published.

Table IV-2.--Fiscal assumptions upon which OSMRE based its economic impact analyses

(Source: Richardson Associates, 1985)

Assumption[1]	Richardson Associates' source of information
Campbell County School District	
Levies that would be assessed, on a per capita basis, would be constant based on the amount of oil sold in the district in 1984 ($655 million) and the amount of coal produced in the district in 1984 ($658 million); other levies would be proportional to population.	(2) and (3)
Revenues would be allocated 6 mills to the State, 12 mills retained, 25 mills to operation and maintenance, and 2.498 mills to capital improvement.	(2)
Expenditures per student would remain constant at the 1984 level of $5,888.	(2)
City of Gillette	
Expenditures would remain constant at 1984 per capita rates.	(2)
Revenues would remain constant at current per capita rates, except as follows:	(2)
Dry Fork use tax would be 0.01 (regular use tax rate) x 0.55 (Gillette share of sales and use tax) x 0.7 (assumption) x value of capital improvements (0.55 changes to 0.60 in 1990).	(3) and (4)
Severance tax would be total severance tax allocated to municipalities x 0.043 (Gillette share of State total (0.043 changes to 0.065 in 1991)).	(3)
Mineral royalties would be ((allocation to municipalities) x (0.071 to 0.075, depending upon year (county share of State population)) x 0.92 (Gillette share of unincorporated population) + (Dry Fork production x $8/ton x 0.125 (mineral royalty rate) x 0.5 (State share of mineral royalties) x 0.075 municipalities' shares of State royalties) x 0.071 to 0.075 (see above) x 0.92 (see above)).	(3) and (5)
Campbell County	
Expenditures would remain constant at 1984 per capita rates.	(2)
Property-tax revenues would depend on the assessed valuation of the school district.	---
Other revenues would remain constant at 1984 per capita rates.	(2)
Dry Fork use tax would be 0.01 (regular use tax rate) x 0.55 (Gillette share of sales and use tax) x 0.7 (assumption) x value of capital improvements (0.55 changes to 0.60 in 1990).	(3) and (4)

[1]These assumptions support a worst case scenario and may not reflect actual conditions at the time this EIS is published.

[2]From Stearns Catalytic Corporation (1985).

[3]From BBC, Inc. (1984).

[4]From Phillips Petroleum Company (1982-86).

[5]From Wyoming Department of Economic Planning and Development (1984).

- The area of the proposed Dry Fork mine would be managed for grazing, wildlife habitat, and the development of oil and gas as resources.

  Livestock stocking rates and management practices would continue at current, premining levels.

  Wildlife management would correspond to Wyoming GFD plans for the area.

  Oil and gas as resources would not be developed beyond the current level.

  Scoria resources would not be developed.

- The area surrounding the proposed Dry Fork mine would be maintained in its current or proposed use.

  The other seven coal mines currently operating or proposed for operation in central Campbell County would continue.

  Coal leasing may continue, but no new mines would be developed.

  Land outside operating/proposed coal mines currently used for agriculture would remain in that use.

  Land outside operating/proposed coal mines currently used for residential purposes would remain in that use. No new residential development would occur north or east of Gillette.

B. IMPACTS OF MINING UNDER ALTERNATIVE 1

1. Air Quality

a. Impacts to air quality from increased particulate levels attributable to mining north and east of Gillette

Surface coal mining operations at the six existing and two proposed mines north and east of Gillette would increase TSP levels at and in the vicinity of these mines, primarily during their operational lives. The location of maximum annual TSP concentrations at the eight mines would shift as mining progresses.

Wyoming DEQ, Air Quality Division, calculated average annual maximum TSP concentrations attributable to mining at the proposed Dry Fork mine based on the Wyoming version of the Climatological-Dispersion Model (CDMW; Busse and Zimmerman, 1973). Based on these calculations, Wyoming DEQ, Air Quality Division, found that maximum TSP concentrations, attributable to the proposed Dry Fork mine alone, would occur when annual coal production at the mine would reach its maximum of 15 million tons and annual surface disturbance would be greatest. At that time, mining at the proposed mine would generate an annual maximum ground-level TSP concentration of 28 $\mu g/m^3$ onsite. According to Wyoming DEQ, Air Quality Division (Charles A. Collins, Wyoming Department of Environmental Quality, Air Quality Division, written communication, December 20, 1985), the maximum background ground-level TSP concentration within the

proposed Dry Fork life-of-mine area is 15 $\mu g/m^3$. Therefore, combined, annual mining-generated and background TSP concentrations within the proposed life-of-mine area would total 43 $\mu g/m^3$, which is well below annual State and Federal TSP standards of 60 and 75 $\mu g/m^3$ (geometric mean), respectively. The maximum annual impact from all mines within the proposed Dry Fork life-of-mine boundary (occurring at a point situated in the north-central part of the proposed life-of-mine area) is 55 $\mu g/m^3$, which is below both State and Federal TSP standards. The maximum cumulative impact predicted from all mines operating simultaneously during the maximum emission year is 59 $\mu g/m^3$ and occurs at a point on the property of the Eagle Butte mine. The impact from the proposed Dry Fork mine at this location is 1 $\mu g/m^3$ (Wyoming Department of Environmental Quality, Air Quality Division, 1986).

Because the annual impacts from the Dry Fork mine meet all applicable State and Federal TSP standards (in effect prior to July 1, 1987), it is likely that the recently promulgated State and Federal PM_{10} standards would be met. On the average, 40 to 50 percent of coal-mining-related particulate emissions from all sources are 10 microns or less in diameter (U.S. Environmental Protection Agency, 1985). Since there is no acceptable conversion factor to correlate PM_{10} and TSP standards with each other, PM_{10} impacts, like TSP impacts, are expected to be moderate within and minor outside the proposed Dry Fork life-of-mine area. Impacts of PM_{10} within and outside the proposed life-of-mine area would be negligible over the long term.

Removing overburden and coal and hauling them along unpaved road surfaces would account for over 70 percent of the 28 $\mu g/m^3$ total maximum annual TSP concentrations generated at the mine (Charles A. Collins, Wyoming Department of Environmental Quality, Air Quality Division, written communication, December 20, 1985). Regional TSP and PM_{10} increases owing to Dry Fork mine emissions would be minor because particles would fall out rapidly and settle close to emission sources.

Wyoming DEQ, Air Quality Division, calculated maximum average annual TSP concentrations attributable to mining seven of the eight mines north and east of Gillette based on the CDMW. The analysis did not take account of emissions from the proposed East Gillette Federal mine, because the Wyoming DEQ air quality permit for that mine had expired. Also, the analysis did not take account of deposition of particulates or gravitational settling (fallout) near the source. Therefore, conclusions based on this Wyoming DEQ, Air Quality Division, modeling analysis are conservative. Mining activities at the proposed East Gillette Federal mine would slightly increase maximum cumulative TSP concentrations in the other seven life-of-mine areas beyond those concentrations shown in figure IV-1, but would not likely contribute to a violation of State or Federal TSP, or Federal PM_{10}, standards at any location. The impact of this small increase would be minor.

On November 19, 1986, Wyoming DEQ, Air Quality Division, issued an "air quality permit to construct" for the Dry Fork mine. (See section E.2 of appendix A.) Normally, if construction does not commence within 24 months of permit issuance, the air quality permit would be revoked. In the present case, the permit has been extended until August 31, 1989, to allow PPC to obtain their pending permit from the Wyoming Industrial Siting Administration and Federal approval of the mining plan (Charles A. Collins, Wyoming Department of Environmental Quality, Air Quality Division, Cheyenne, Wyoming, written communication, November, 28, 1988).

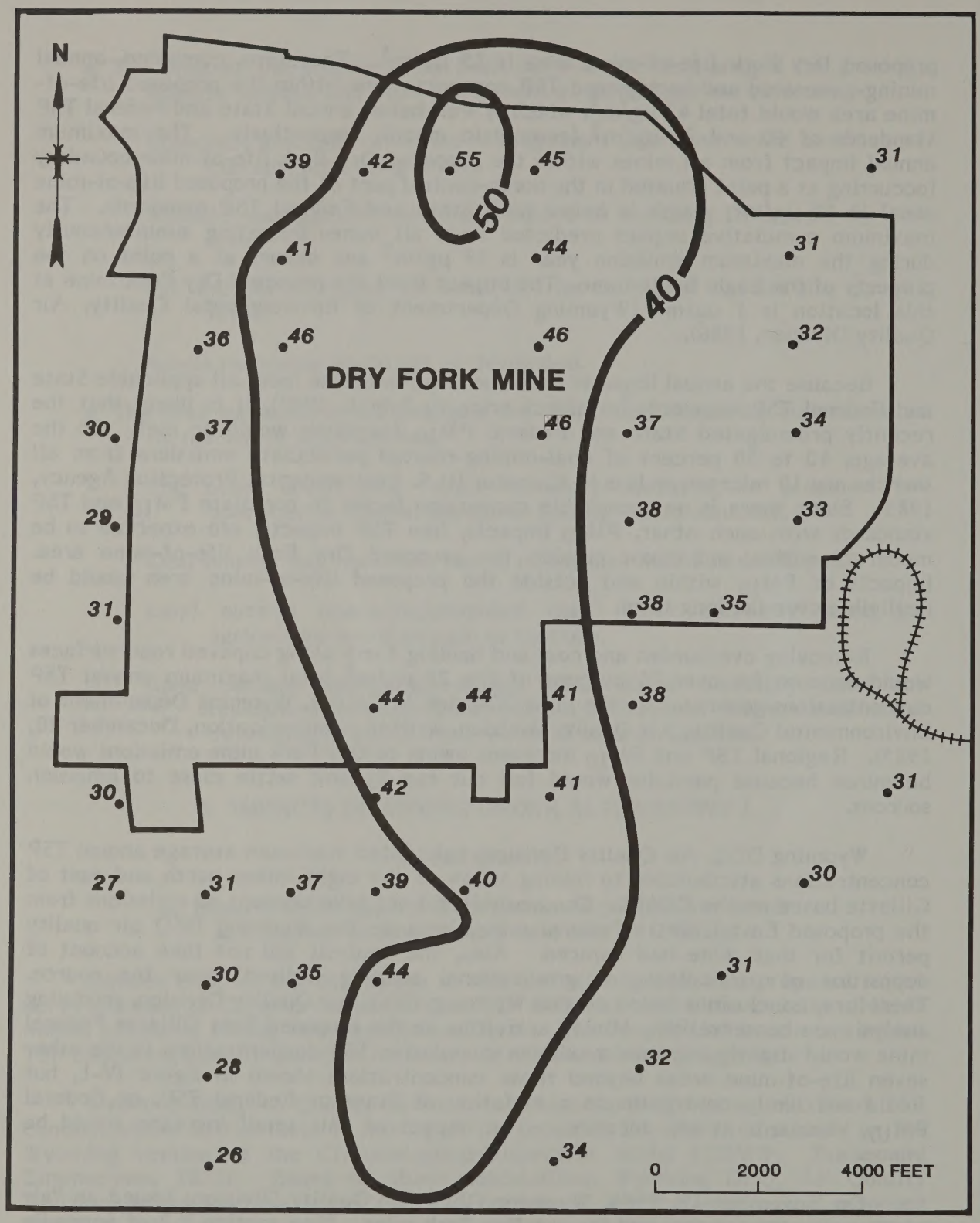

Figure IV-1.--Maximum TSP concentrations ($\mu g/m^3$) that would be attributable to surface coal mining operations at seven of the eight existing and proposed mines (excluding the proposed East Gillette Federal mine) north and east of Gillette. Concentrations shown would occur in 1995, the year of presumed maximum emissions. (Source: Wyoming Department of Environmental Quality, Air Quality Division, 1986.)

Under high wind speed conditions, emissions from the eight mines, including the proposed Dry Fork mine, could exceed both the 24-hour Wyoming TSP standard of 150 $\mu g/m^3$ (geometric mean) and the Federal PM_{10} standard of 150 $\mu g/m^3$ (arithmetic mean) within and in the vicinity of the eight life-of-mine areas. Likewise, emissions from the eight mines could exceed both the 24-hour Wyoming TSP standard and the Federal PM_{10} standard in Gillette when high winds blow particulates from the eight mine area toward Gillette.

OSMRE concludes that impacts to air quality from increased particulate levels at the proposed Dry Fork mine would be moderate within and minor outside the Dry Fork life-of-mine area over the short term. Impacts would be negligible over the long term. The eight surface coal mines operating simultaneously at maximum production under highest projected emissions conditions would cause a moderate short-term increase in both TSP and PM_{10} concentrations within the proposed Dry Fork life-of-mine area and a moderate, short-term increase outside the life-of-mine area. Increases in TSP and PM_{10} concentrations both within and outside the eight life-of-mine areas would be minor over the long term.

2. Geology

a. Impacts of the proposed Dry Fork mine on the scoria resource within the life-of-mine area

Approximately 12 million bank cubic yards of scoria deposits are present within the proposed life-of-mine area. (See figure A-3 for the locations of these deposits.) PPC proposes to use approximately 3.8 million bank cubic yards of this material (32 percent of the scoria within the proposed life-of-mine area) over the life of its mine for the purposes of construction and haul-road maintenance. When the area is reclaimed, this 3.8 million bank cubic yards of scoria would either be removed and deposited in the pit or left and covered with 26 inches of topsoil; in consequence, it would be unavailable for any future use and so, in effect, would be permanently lost. An undetermined amount of scoria in the disturbed area would be removed, along with other overburden material, and indiscriminately deposited in the spoil. This scoria would also be permanently lost to future use. Sizeable deposits of scoria within the proposed life-of-mine area would remain undisturbed. Currently, PPC has no plans to develop this scoria resource because no demand exists for it. If a demand were to materialize, the scoria resource could be developed either concurrently with coal mining or after coal mining had been completed.

OSMRE concludes that the impact of the proposed Dry Fork mine on the scoria resource within the proposed life-of-mine area would be minor over the long term because a relatively low percentage of the resources would be extracted or mined through. The reserves that would be mined or disturbed would be permanently lost. The resources that would not be mined or disturbed could be recovered over the short term (during mining) or the long term (after mining).

b. Impacts of the proposed Dry Fork mine on oil production within the life-of-mine area

Three currently producing oil wells are present within the life-of-mine area. (See the "Land Use" section of chapter III for their location.) These wells would be capped below the lowest coal seam and mined through. PPC is committed to restoring the three oil wells once it completes final backfilling and grading of the

area in which they are located; however, at the time active mining or reclamation was occurring in this area, these wells could have completed oil production and so would not require restoration. The oil and gas production zone underlying the proposed life-of-mine area occurs in the Muddy Sandstone, which is over 6,000 feet below the lowest coal seam to be mined. Given the depth of this production zone, no damage to future oil and gas production would occur as a result of mining.

OSMRE concludes that the impact of the proposed Dry Fork mine on oil production within the proposed life-of-mine area would be negligible over the short term.

3. Topography

a. Impacts of lowering and flattening the life-of-mine areas north and east of Gillette

Approximately 2,905 acres would be disturbed by mining and mining-related operations at the proposed Dry Fork mine. The result of these operations would be that the final postmining elevation would average about 34 feet lower than premining elevation. The overall postmining topography would be substantially flatter than premining topography.

Premining slopes average 8.2 percent (fig. IV-2), whereas the postmining slopes are expected to average 1.1 percent. The postmining slopes would range from 1 to 26 percent, thus maintaining some topographic diversity (fig. IV-3). PPC would be prevented from returning the mined area to its approximate original contour because of the thin overburden in the area and the need to reduce maximum slopes. It would, however, adhere to the thin-overburden criteria of the Wyoming DEQ regulations (Chapter IV, Section 3, Wyoming DEQ, Land Quality Division Rules and Regulations).

Two additional streams, Marshall Draw and Dry Draw, and five impoundments would become part of the postmining topography. The five impoundments are to replace existing stockponds that would be mined through.

The primary historical premining land uses are livestock grazing and wildlife habitat. Other premining land uses are oil and gas production, hay production, and recreation. The reclamation plan proposes to return all postmining lands to the primary original land use of livestock grazing and wildlife habitat.

A generally flatter topography could have two beneficial impacts on the reclaimed land surface. First, a flatter land surface would allow for greater infiltration of precipitation, thereby increasing the viability of the postmining vegetation. Second, a flatter land surface could result in a reduction in erosion of reclaimed soils.

Mining activities at the eight mines north and east of Gillette would remove about 80 to 100 vertical feet of coal from coal seams underlying the eight life-of-mine areas. Given that the average thickness of overburden in the life-of-mine areas is about 100 to 150 feet, and the spoil swell factor in the areas is about 14 to 18 percent, mining activities at the eight mines would lower the elevation of disturbed acreage within the eight life-of-mine areas (approximately 21,744 acres of land) by approximately 50 feet. These activities would also flatten the disturbed acreage.

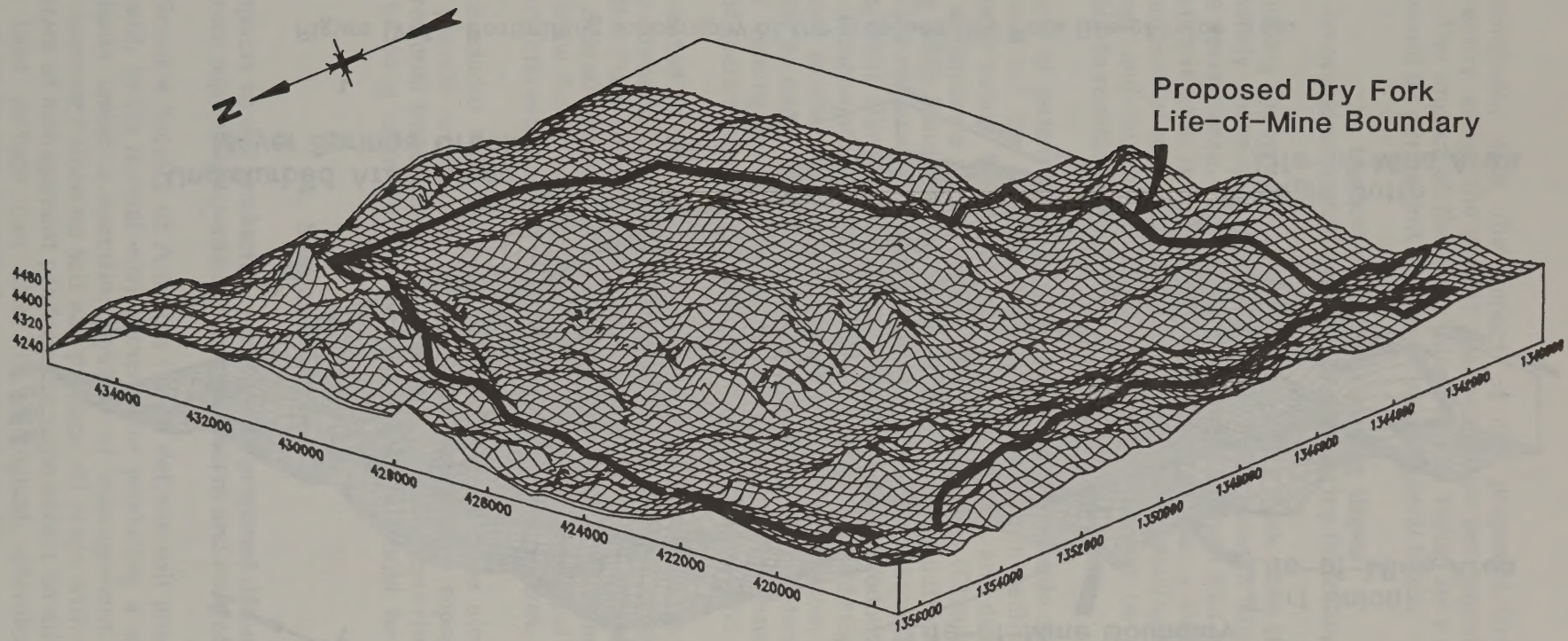

Figure IV-2.--Premining topography of the Dry Fork property.

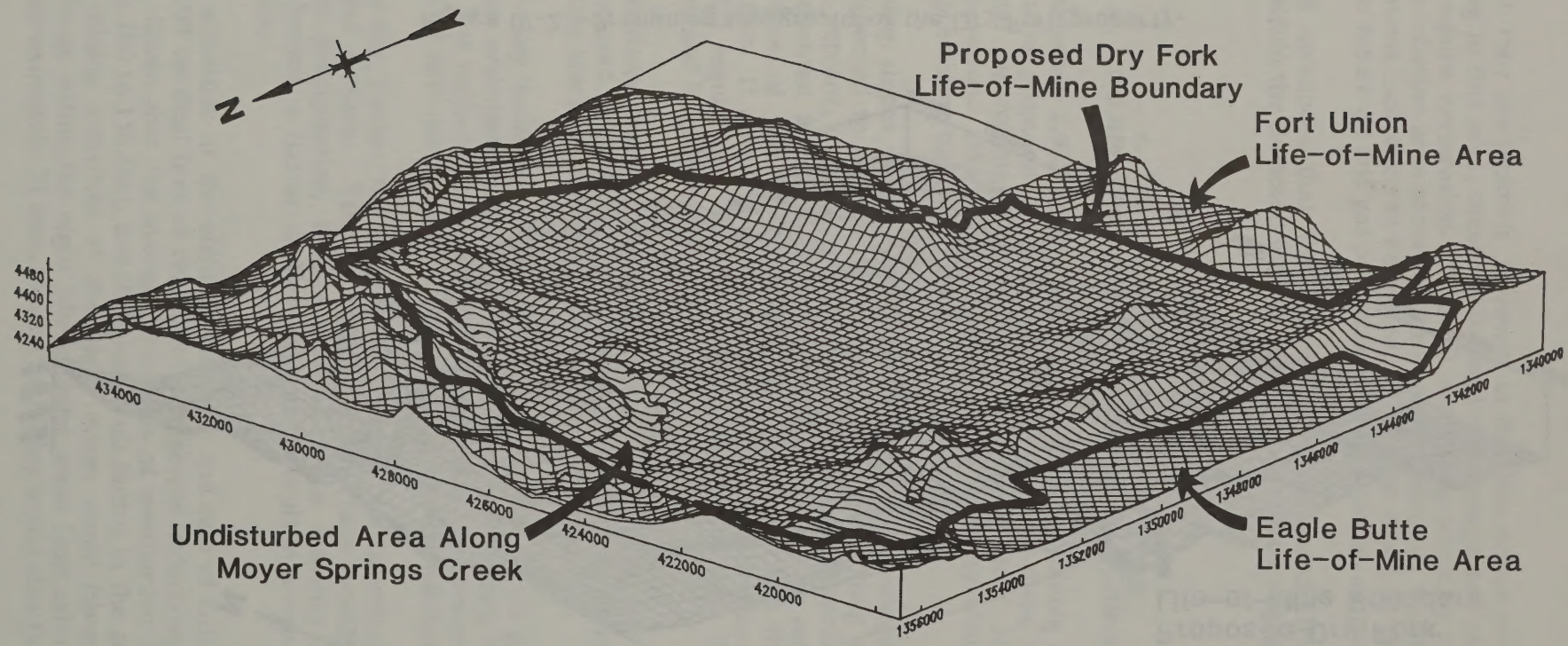

Figure IV-3.--Postmining topography of the proposed Dry Fork life-of-mine area.

OSMRE concludes that the impact of the proposed Dry Fork mine on topographic diversity within the permit area would be permanent but minor on a regional basis. The impact of the eight mines on the topography of the eight life-of-mine areas would be permanent but minor on a regional basis.

b. Impacts of long postmining slopes on erosional stability at the proposed Dry Fork mine

The postmining topography of the proposed Dry Fork mine (fig. IV-3) shows a ridge approximately three-quarters of a mile long, located along the southeast boundary of the permit area. The slope that descends from this ridge towards the center of the permit area is roughly 800 feet long and has a slope of 15 percent. The proposed methods of erosion control include training dikes/berms, tilling on the contour, seeding, and mulching. These techniques should be adequate only if vegetation is able to reestablish quickly.

The impacts of potentially having an erosionally unstable slope could include the loss of topsoil off the reclaimed area, an increase in sediment yield to the receiving sediment ponds, failure of revegetation efforts, and development of rills and gullies. In accordance with Wyoming DEQ regulations (Chapter IV, Sections 2 and 3, Wyoming DEQ, Land Quality Division Rules and Regulations), PPC and other mine operators are required to meet minimum performance standards for repairing rills and gullies, controlling erosion, minimizing sediment production, and ensuring slope stability. Noncompliance during mining operations would result in a notice of violation. Failure to abate the conditions for which the violation was issued would result in an order to cease mining. Failure to correct the problem within 10 years of the end of mining and reclamation activities would result in either the postponement of reclamation bond release or the forfeiture of the bonds.

PPC attempted to develop an overstripping agreement with the Shaw Ranch, the adjacent landowners, similar to the agreement already in place on nearby land controlled by the Fort Union Mine Partnership. Such an agreement would have reduced the overall slope and alleviated this potential erosional instability concern. The Shaw Ranch has no interest in developing the coal resources in this area and was not interested in any mutual overstripping activities.

OSMRE concludes that the existence of the long slope along the southeast border of the permit area as a part of the postmining topography could be conducive to erosional instability. The impact of erosion occurring on this slope is considered to be long term and minor. The impact would be negligible on a regional basis.

4. Soils and Overburden

a. Impacts to soil productivity within the proposed life-of-mine areas from topsoiling operations at mines north and east of Gillette

The Soil Science Society of America (1979) defines soil productivity as "the capacity of a soil, in its normal environment, for producing a specified plant or sequence of plants under a specified system of management. The specified limitations are necessary since no soil can produce all crops with equal success nor can a single system of management produce the same effect on all soils." Stripping soil from the land surface can alter its biological, chemical, and physical characteristics, which in turn contribute to its productivity.

Activities at PPC's proposed Dry Fork mine would adversely affect the approximate 10,053,000 bank cubic yards (6,231 acre-feet) of topsoil material that would be salvaged in the 2,905-acre disturbance area at the proposed mine. Activities at the eight mines north and east of Gillette would adversely affect the soil-forming processes of the approximate 46,650 acre-feet of topsoil material that would be salvaged in the 21,744-acre disturbance area at the mines. (Six soil series, common to all eight life-of-mine areas, account for approximately 21,523 acre-feet of strippable topsoil (table III-3). This topsoil plus the other 25,127 acre-feet of suitable topsoil material within the eight life-of-mine areas total 46,650 acre-feet of topsoil material suitable for reclamation.) Specifically, these activities would irreversibly alter some soil characteristics, including soil structure, texture, erodibility, salinity, biological activity, and nutrient content. In consequence, the taxonomic classification of these soils would change. Stockpiling topsoil material at the proposed Dry Fork mine for several years (from a minimum of 2 years for stockpiles T-8 and T-9 to a maximum of 28 years for stockpile T-1) would change its productive capacity by decreasing its nutrient content, native seed viability, and microbial activity. (See plate 1 for the locations of the major topsoil stockpiles.)

The total productivity of the 21,744 disturbed acres at the eight mines, including the 2,905 disturbed acres at the proposed Dry Fork mine, would probably remain at about its premining level, although productivity could change locally because (1) reclaimed soils would be more uniformly thick (19 to 35 inches of topsoil (with an average of 25 inches) would be replaced on regraded spoil at the eight mines; 22 to 28 inches of topsoil would be replaced on regraded spoil at the proposed Dry Fork mine) than premining soils, especially on rough and broken land where rock outcrops existed prior to mining and in other areas where soil had been relatively thin and unproductive and (2) after mining, poorer soils, such as those with clayey texture or high salinity, would be mixed with other topsoil materials to a more uniform physical and chemical composition. Once these mixed soils were redistributed across the disturbed area, productivity and erodibility in that area would be more uniform. Productivity of postmining soils would also increase somewhat owing to a general reduction of slopes in the reclaimed landscape.

Wyoming DEQ regulations (Chapter IV, Section 2, Wyoming DEQ, Land Quality Division Rules and Regulations) and Wyoming DEQ, Land Quality Division, guideline No. 2 specify that, before a bond is released on a reclaimed area, the vegetation cover and productivity of the area must equal the premine control-area cover and production within the statistical parameters allowed under the regulations. Therefore, at the time the bonds for each of the eight mines are released, the productivity of disturbed acreage within the eight life-of-mine areas could be slightly reduced from premining productivity. Over the long term, however, the productivity of all mined areas should eventually equal or exceed premining productivity, because mining would eliminate nonproductive rock outcrop areas and reclamation would intermix relatively unproductive soils with those that were more productive. Replaced topsoil should support stable and productive vegetation adequate in quantity and kind to support the planned postmining land uses of wildlife habitat and grazing land.

OSMRE concludes that the impact of the eight mines, including the proposed Dry Fork mine, on soil productivity within the eight life-of-mine areas would be negligible over the long term.

b. Impacts on revegetation success and ground-water quality of unsuitable overburden at mines north and east of Gillette

Wyoming DEQ regulations (Chapter IV, Section 2, Wyoming DEQ, Land Quality Division Rules and Regulations) require that unsuitable overburden disturbed by mining be (1) buried under at least 4 feet of suitable overburden and/or topsoil and (2) handled and placed to prevent degradation of the ground water. Wyoming DEQ, Land Quality Division, guideline No. 1 suggests that, initially, the suitability of overburden for use in reclamation be determined by drilling a minimum of four core holes per section or one per 160 acres. These core holes should then be analyzed for 12 geochemical parameters specified by the guideline. Depending on the results of the initial analysis, more intensive sampling and analyses may be necessary to accurately assess the geochemistry of the overburden.

PPC would handle approximately 282,366,000 bank cubic yards of overburden in the course of mining the 2,905 acres that would be disturbed within its proposed life-of-mine area. PPC drilled and sampled 28 overburden core holes in this acreage and analyzed them for geochemical parameters in accordance with Wyoming DEQ, Land Quality Division, guideline No. 1. Twenty-three of the holes contained zones of unsuitable overburden. According to Dollhopf and others (1978), most unsuitable overburden disturbed by standard mining and reclamation activities is diluted as a matter of course, because it is mixed with suitable overburden in the spoil. Using Dollhopf and others' method, PPC found that, after regrading and contouring, some spoil at its proposed mine would still remain unsuitable for use in reclamation; this spoil would be characterized by high clay content, excessive acid-base potential, and excessive nitrate/nitrogen concentrations. Specifically, PPC found that approximately 19,050,000 bank cubic yards of overburden, or about 6.3 percent of total overburden to be handled, would contain excessive unsuitable material and so would have to be specially handled. PPC would bury the most undesirable spoil (highly carbonaceous units, coal rider seams, and other toxic material as necessary) in designated areas at the base of the pit and seal it with an impermeable layer of nontoxic material. Other less toxic spoil would be replaced in the reclaimed spoils below the vegetation rooting zone, above the ground-water postmining potentiometric surface, and outside the area of drainage channels or their flood plains.

The permittees of the other seven mines north and east of Gillette have conducted sampling and geochemical analyses according to Wyoming DEQ, Land Quality Division, guideline No. 1. Their data show that some cores or parts of cores from all life-of-mine areas exceed guideline No. 1 standards; thus, all these life-of-mine areas contain some unsuitable overburden. Wyodak Resource Development Corporation has identified 55,350,000 cubic yards of in-place unsuitable overburden at its Wyodak mine (Wyoming Resource Development Corporation, 1981-86). AMAX Coal Company, Carter Mining Company, Frontier Coal Company, Kerr-McGee Coal Corporation, and Triton Coal Company have not identified specific amounts of unsuitable overburden at their mines. However, these data also show that the life-of-mine areas contain sufficient suitable overburden and/or topsoil to furnish at least 4 feet of cover for any unsuitable overburden. Also, each of the permittees has developed a program to specially handle unsuitable overburden and to monitor and sample regraded spoil. The sampling density these programs propose vary from 100-foot centers to 660-foot centers or from approximately one sample per one-quarter of an acre to one per 10 acres. Should the sampling programs identify unsuitable overburden, each further

proposes measures that, when implemented, would assure that unsuitable overburden would not interfere with revegetation or degrade ground water.

OSMRE concludes that the impact of unsuitable overburden at the eight mines, including the proposed Dry Fork mine, on revegetation success and ground-water quality would be negligible over the long term.

5. Hydrology

a. Impact of mining north and east of Gillette on the quantity of flow from Moyer Springs

OSMRE developed a finite difference ground-water model, which is a modified version of the Prickett-Lonnquist finite difference model, to predict the impact, to the coal/scoria aquifer and the flow of Moyer Springs, of mining (1) the six existing and two proposed mines north and east of Gillette (for use in alternative 1) and (2) seven of these eight mines, excluding the proposed Dry Fork mine (for use in alternative 3). (With reference to results from this model's runs, OSMRE refers to the coal and scoria aquifers together as "the coal/scoria aquifer." See chapter III.) The difference between model results for the eight mines and seven of the eight mines constitutes the incremental impact of the proposed Dry Fork mine on the coal/scoria aquifer and the flow of Moyer Springs.

PPC made predictions similar to OSMRE's using a finite difference ground-water model (Phillips Petroleum Company, 1982-86). OSMRE's predictions (fully described in appendix D) differed from PPC's in that OSMRE's model (1) used a larger area than PPC's model used, to both avoid boundary effects and take account of the Buckskin, Rawhide, and Wyodak mines, (2) took account of Fort Union mine's pit No. 2, which was not proposed for mining at the time PPC conducted its analyses but which now has been permitted, and (3) used different routines (constant-head nodes instead of wells) than PPC's model used to simulate mining.

Figure IV-4 shows the flows in Moyer Springs Creek and Moyer Springs, with and without the proposed Dry Fork mine, as predicted by OSMRE's model. Specifically, the model predicts that the maximum reduction in outflow of Moyer Springs and Moyer Springs Creek attributable to mining the eight mines, including flow depletion attributable to mining the proposed Dry Fork mine, would be 25 and 22 percent, respectively. This maximum reduction would occur only for short periods (in years 4 and 15 of coal removal at the proposed Dry Fork mine; years 6 and 17 of the life-of-mine operation), when the mine pit would be closest to the spring. On average, flows in the spring and creek would be depleted by about 13 percent over the 34-year life of the mine. Flows would remain depleted less than 5 percent for as long as 200 years after reclamation of the eight mines as the potentiometric surface slowly recovered. If the Dry Fork mine permit application were not approved and the Dry Fork property were not mined, the seven other existing and proposed mines together would deplete springflow by a maximum of about 5 percent. Thus, OSMRE's model predicts the Dry Fork mine alone would account for a maximum 20-percent flow reduction at Moyer Springs.

PPC's independently performed analyses, using its ground-water model, also predicted that the eight mines together would deplete the flow of Moyer Springs by

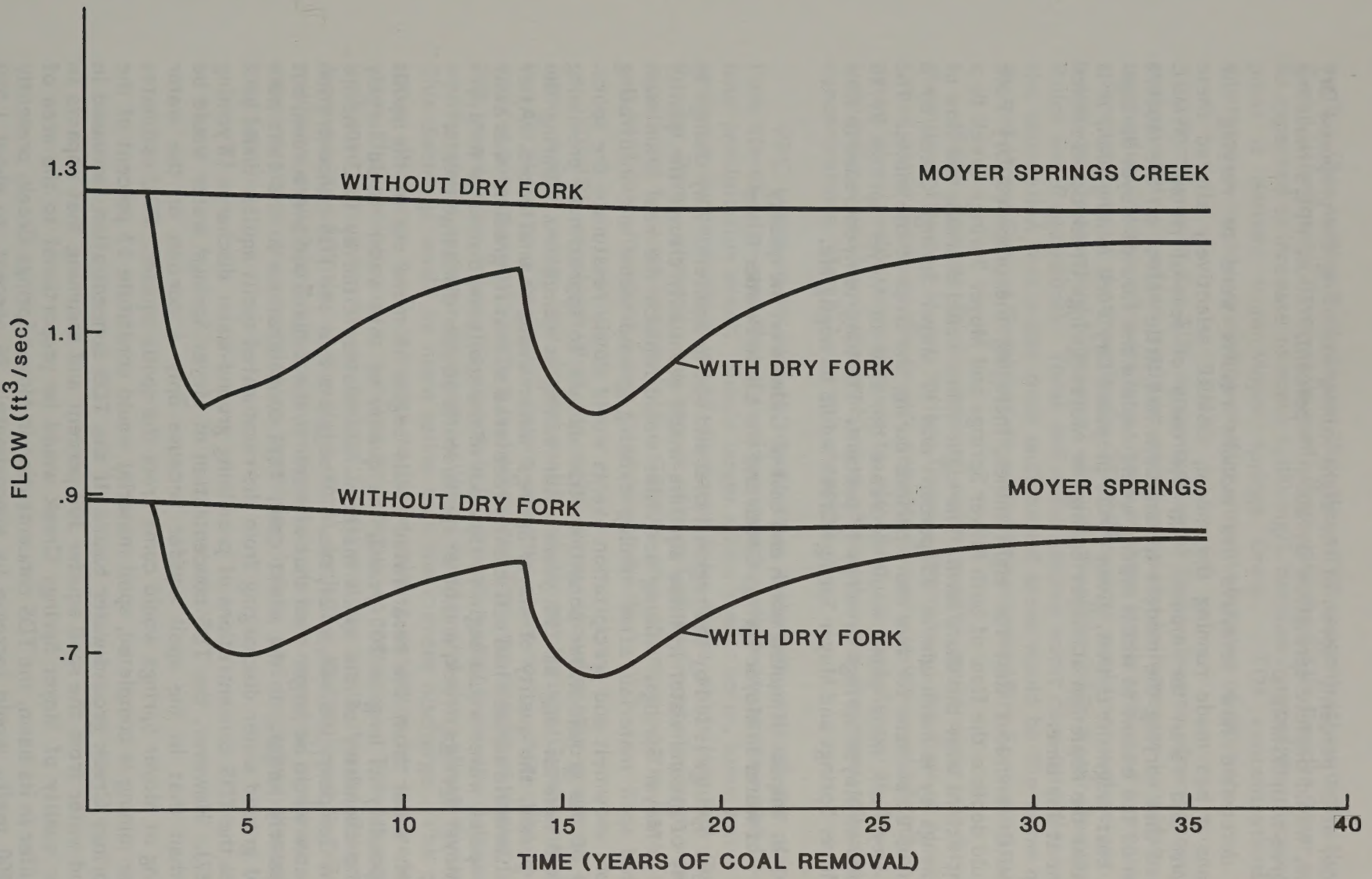

Figure IV-4.--Predicted flows of Moyer Springs Creek and Moyer Springs, with and without the proposed Dry Fork mine.

a maximum of 25 percent; seven of the eight mines, excluding the proposed Dry Fork mine, would deplete springflow by about 5 percent. Thus, PPC's modeling results agree with OSMRE's.

To determine how sensitive its model's results were to varying the assumptions it had made running the model, OSMRE selectively altered these assumptions and reran the model. On the basis of several reruns, OSMRE determined that varying the model's assumptions had little effect on the model's prediction of the extent to which mining would deplete the flow of Moyer Springs. OSMRE's best judgment is that, given PPC's proposed Dry Fork mining plan, it is unlikely that the depletion of Moyer Springs or Moyer Springs Creek could exceed 30 percent at any time.

OSMRE concludes that the eight mines, including the proposed Dry Fork mine, would deplete the flow of both Moyer Springs and Moyer Springs Creek to a significant extent over the short term. The eight mines would decrease the flow of Moyer Springs by a maximum of 25 percent and of Moyer Springs Creek by a maximum of 22 percent for two short periods during the lives of the mines. The proposed Dry Fork mine alone would decrease the flow of Moyer Springs by 20 percent and of Moyer Springs Creek by 17 percent. The long-term decrease in flow of both Moyer Springs and Moyer Springs Creek would be negligible.

b. Impact of mining north and east of Gillette on the quality of water in Moyer Springs Creek and the Little Powder River

Moyer Springs is fed by the regional coal and scoria aquifers. Any change in the quality of ground water in these aquifers would eventually change the quality of water in Moyer Springs. Mining activities would replace the coal seam with unsaturated spoil material; after mining, existing ground water and infiltrating water from snowmelt and precipitation events would slowly resaturate the spoils. Recovery of the ground-water potentiometric surface to approximate premining levels could take as long as 200 years after mining is completed. During the recovery period, the quality of Moyer Springs' water would be unaffected. After the potentiometric surface had sufficiently recovered so that its gradient was away from the spoils, water would begin to flow out of the spoils and discharge to Moyer Springs, Moyer Springs Creek, and other spoils/scoria aquifer discharge points.

When water from the resaturated spoils begins to move out of the spoils aquifer (possibly as long as 200 years), the quality of that water would largely reflect the chemistry of the spoils material. Literature cited by PPC (Phillips Petroleum Company, 1982-86, v. 21, sec. 8.2) suggests that the TDS concentration of this water would be larger than that of water in the undisturbed overburden, but not excessively larger. In the worst case, TDS concentrations in the first pore volume of ground water discharging from the resaturated spoils aquifer could be 2 to 3 times the TDS concentrations of premining ground-water discharge (Wyoming DEQ, 1987). However, the TDS concentration of Moyer Springs' water would be smaller than that in the spoil aquifer because only a portion of the water discharging at Moyer Springs would come from the spoils aquifer. PPC estimates that, after mining is completed, spoil material would constitute 13 percent of the Moyer Springs Creek ground-water basin. If the TDS concentration increased in the ground water from the spoil aquifer 300 percent and assuming that impacts to the water quality of Moyer Springs Creek would be proportional to the area of spoils aquifer in its basin, the TDS concentration in Moyer Springs Creek, presently about 1,200 mg/L, would increase by approximately 26 percent, to about 1,500

mg/L. (See section E of chapter III.) Mean TDS concentrations in the flows of Dry Fork Little Powder River at its confluence with the Little Powder River would also be expected to increase to about 1,500 mg/L because most of the discharge at this point is derived from Moyer Springs Creek. TDS concentrations farther downstream would increase by smaller amounts because of dilution.

Increases in the TDS concentration of these streams after recovery of the potentiometric surface would be owing primarily to increases in sulfate, calcium, magnesium, and bicarbonate ions. None of these ions is toxic and increases in their concentrations of the magnitudes OSMRE expects would not violate any Wyoming water-quality standard (Chapters I and VIII, Wyoming DEQ, Water Quality Division Rules and Regulations). These estimates assume worst case conditions, including the assumption that water from undisturbed areas would be the same quality as that of Moyer Springs Creek before mining the proposed Dry Fork mine.

Other impacts to downstream water quality could occur as the result of diminished flows in Moyer Springs Creek. Decreasing the flow of Moyer Springs Creek could decrease the creek's velocity in some sections, which might, in turn, cause the creek's temperature to rise and its turbulence to lower. Lower turbulence would lower the coefficient of aeration and thus lower dissolved oxygen concentrations. (See B.7.a of this chapter.)

PPC would route surface runoff from disturbed parts of the proposed Dry Fork life-of-mine area through sediment ponds designed to contain the 10-year, 24-hour precipitation event. Should larger storm events occur, some water with high sediment concentrations would discharge from these ponds into Dry Fork Little Powder River. However, the impact of such high sediment discharge would not be significant because streams in the Gillette area commonly carry water with high sediment concentrations during large runoff events.

OSMRE concludes that the eight mines, including the proposed Dry Fork mine, would change the water quality of Moyer Springs Creek and the Little Powder River to a negligible extent over the short term. After the spoil/scoria aquifer potentiometric surface had recovered from the impact of mining (as long as 200 years after mining is completed), ground water from the reclaimed spoil aquifer would begin to discharge at Moyer Springs and along Moyer Springs Creek. This discharge would be more saline than the current discharge. The quality of spring discharge may not return to its premining condition for hundreds of years after the potentiometric surface had begun to recover. The impact of this increased salinity in Moyer Springs Creek and the Little Powder River resulting from mining activities at the eight mines, including the proposed Dry Fork mine, would be negligible while the potentiometric surface recovers, moderate while TDS concentrations are reverting to premining levels, and negligible thereafter (i.e., long term).

c. Impact of mining north and east of Gillette on water levels in existing appropriated wells developed in both the coal and scoria aquifers, including wells for local ranching operations and the domestic wells serving the Garner Lake housing development

Mining the proposed Dry Fork life-of-mine area would draw down water levels in both the coal and scoria aquifers. Drawdowns in the scoria aquifer to the east of the proposed life-of-mine area would extend only a short distance owing to the high transmissivity of the scoria aquifer. Because mining to the south and west of the proposed life-of-mine area would already have drawn down water levels in these aquifers in their vicinity, drawdowns attributable to mining the proposed mine would occur almost totally within the proposed life-of-mine area. In consequence, OSMRE's model predicts that slight drawdowns caused by mining the proposed Dry Fork mine would extend farther to the east than in other directions, and relatively large drawdowns caused by mining (drawdowns of 10 feet or more) would be confined to the proposed life-of-mine area.

The eight mines would draw down the coal/scoria aquifer extensively. Figure V-3 in appendix D shows the drawdowns OSMRE calculates would have occurred at the end of mining all eight mines, by which time drawdowns would be extensive (greater than 5 feet throughout the extent of the eight life-of-mine areas except in the scoria aquifer). Figure V-8 in the appendix shows drawdowns that would be attributable to mining seven of these eight mines, excluding the proposed Dry Fork mine. The difference between drawdowns shown in the figures constitutes the amount of drawdown that would be attributable to the proposed Dry Fork mine alone. Areas west and south of the proposed life-of-mine area would be essentially unaffected by mining the proposed Dry Fork mine.

The eight mines would affect wells completed in the coal aquifer to a significant extent over the short term. Most wells in the coal aquifer are mining company coal monitoring wells. However, PPC lists 27 coal aquifer wells within 3 miles of its proposed Dry Fork life-of-mine area boundary that appropriate ground water for use (i.e., nonmonitoring wells; Phillips Petroleum Company, 1982-86). The water levels in all of these wells would be lowered: some may be destroyed by mining; others may go dry owing to the large predicted fall in the coal aquifer potentiometric surface. However, this impact would be negligible over the long term because water levels would eventually recover to their premining conditions.

The proposed Dry Fork mine alone would lower the water level more than 5 feet in only one appropriated well, the Shaw 1 well. (An appropriated well, as a right granted by the State, withdraws ground water for use and is not a coal aquifer monitoring well.) The Shaw 1 well is located in the SW¼ sec. 31, T. 51 N., R. 71 W. G. W. Graves applied to the State for ground-water rights for this 180-foot-deep well, which is used for livestock watering. The depth to the water in the Shaw 1 well is approximately 60 feet; the well's yield is 2 gal/min. OSMRE predicts the proposed Dry Fork mine would draw down the well about 35 to 40 feet. Because water in the Shaw 1 well is about 120 feet deep, for mining to draw the well down by 35 to 40 feet should not affect its viability as a source of ground water. Declines in water levels in all other wells in the coal and scoria aquifers, attributable to mining the proposed Dry Fork mine, would be less than 5 feet and therefore negligible.

Wells in the scoria aquifer, including the Garner Lake subdivision wells, would be affected by mining the eight mines. Drawdowns in the scoria aquifer would be small because of the aquifer's large hydraulic conductivity and specific yield.

OSMRE concludes that mining at the proposed Dry Fork mine would have negligible impacts on water levels in existing appropriated wells developed into either the coal or the scoria aquifer over both the short and long term. The impact of mining the eight mines on water levels in wells in the coal aquifer would be significant over the short term. The impact of mining on water levels in wells in the scoria aquifer would be negligible over the short term. Long-term impacts on wells in both aquifers would be negligible.

d. Impacts of water-supply wells at mines north and east of Gillette on water levels in the Tullock Member of the Fort Union Formation

The proposed Dry Fork mine water-supply well would be completed in a zone of the Tullock Member of the Fort Union Formation about 750 feet below the land surface. Assuming a continuous pumping rate for this well of 100 gal/min, a transmissivity of 2,170 gal/day per foot, and a storage coefficient of 0.00013, PPC calculated that, after 30 years of pumping, the 5-foot drawdown contour of the well would be located 31.5 miles from it (Phillips Petroleum Company, 1982-86).

PPC submitted an analysis to OSMRE of the combined impacts of its water-supply well and the 37 other wells completed in the Tullock Member of the Fort Union Formation, in T. 50, 51, and 52 N., R. 70, 71, 72, and 73 W., within 31.5 miles of its proposed water-supply well (Phillips Petroleum Company, v. 17, appendix A). The proposed Dry Fork mine water-supply well alone would lower the potentiometric surface at these wells less than 60 feet. For the cumulative impact, all 38 wells were assumed to be pumped at their permitted rates of appropriation for 30 years (i.e., maximum pumpage) and were assumed to be at a single location (i.e., W½ sec. 12, T. 50 N., R. 72 W., about 3.5 miles south of PPC's proposed well). The resulting 5-foot drawdown contour would be at a distance of 61 miles from the combined well. At a distance of 5 miles, drawdown was predicted to be 663 feet. Since there is typically over a thousand feet of available head in these wells, even under the worst case scenario used in this analysis, there would still be approximately 300 feet of water in the aquifer.

A more conventional analysis of potentiometric surface drawdowns in the Tullock Member was conducted by OSMRE (McIntosh and others, 1984). Theis simulations of the wells in their actual locations were used to examine the effects of cumulative pumping over a 30-year period. In this study, OSMRE found that (1) there are no meaningful correlations between the completion intervals of mine facility wells and nonmine wells, and (2) drawdowns of the potentiometric surface in the vicinity of the pumping wells would be on the order of 155 feet after 30 years. OSMRE concluded that there would be no chance of dewatering the Tullock aquifer in the area north and east of Gillette and that the pumping of mine facility wells should have a minimal impact upon other water users in the area.

Lowering the aquifer's potentiometric surface would not decrease the availability of water, but it would increase the pumping costs necessary to obtain the water. The duration of this impact is unknown; many of the Tullock aquifer wells are mine water-supply wells and would be abandoned at the completion of mining. However, other wells would remain as long as water remained in the aquifer and cumulative drawdowns would persist.

OSMRE concludes that mine-related water-supply wells would lower the potentiometric surface in the Tullock Member of the Fort Union Formation. The cumulative impact of the Fort Union Formation water-supply wells, including the eight mines' water-supply wells, would be to increase the pumping costs for all of them. This would be a moderate impact to well users in the short term and minor impact to users over the long term.

e. Impacts of mining north and east of Gillette on downstream land and water use, including (1) impacts from potential excessive water discharges and (2) impacts to local ranching operations from reduction in surface-water flows

The predominant land use in the Gillette area is dryland livestock grazing. Streams in the area provide some water for livestock; subirrigation enhances the production of forage for livestock in alluvial bottomlands along the streams. During high flows, Gillette area water users commonly divert streamflows either for use to flood-irrigate forage on higher terraces along the streams or to be stored in reservoirs and used later during drier periods of the year. These downstream land and water uses could be adversely affected by depleting the flow of Moyer Springs and by retaining surface runoff from disturbed portions of the eight life-of-mine areas in sediment ponds, thereby reducing surface-water flows.

OSMRE estimates that mining eight mines north and east of Gillette, including the proposed Dry Fork mine, would reduce the flow of Moyer Springs by a maximum of 25 percent. OSMRE calculates that reducing the flow of Moyer Springs by 25 percent would reduce the downstream average annual flows in Dry Fork Little Powder River and the Little Powder River to the extents shown in table IV-3. (OSMRE calculated downstream average annual flows by apportioning the average annual flow measured at gaging station No. 06324970 according to subdrainage areas upstream of the gaging station. However, OSMRE's calculations for flow reductions may be high because pit pumpage could replace part of the downstream flow OSMRE estimates would be depleted.)

Detaining surface runoff in sedimentation ponds within the eight life-of-mine areas would affect flows downstream from the life-of-mine areas by reducing both the total volume of flow and peak-flow rates. Based on annual flow estimates (table III-3), and assuming that all surface runoff from the disturbed parts of the eight life-of-mine areas were detained in sedimentation ponds that were not later dewatered, OSMRE estimates the average annual flow of the Little Powder River at the mouth of Rawhide Creek would be reduced by 8 percent. However, if the eight mine operators would dewater some or all sedimentation ponds within 15 days of a runoff event, in accordance with Wyoming DEQ guideline No. 8, the actual reduction in average annual flow volume would be much less than 8 percent. Any reduction in downstream surface-water runoff would occur during the life of the mines, because most of the ponds would be removed after mining and reclamation were completed.

PPC and other mine operators would pump water from the mine pits and use most of it for dust control. They would pump pit water not used for dust control into holding ponds. Mine pit water from these ponds would be discharged into Dry Fork Little Powder River only when the volume of water they received exceeded the storage volume of the ponds. In accordance with Wyoming DEQ regulations (Chapter X, Section 4, Wyoming DEQ, Water Quality Division Rules and Regulations), PPC and other mine operators would ensure that all discharges met

Table IV-3.--Maximum reductions in flows of Dry Fork Little Powder River and the Little Powder River owing to a reduction in flow of Moyer Springs attributable to all eight mines north and east of Gillette

Stream	Reduction in flow (percent)
Dry Fork above Little Powder River	15
Little Powder River at confluence of Rawhide Creek	7.6
Little Powder River near Weston, Wyoming	1.8

Wyoming DEQ's effluent standards and the effluent standards of its National Pollutant Discharge Effluent Standard (NPDES) permit. Maximum discharge to Dry Fork Little Powder River from the proposed Dry Fork mine would occur in years 3 through 7 and in years 15 through 20 of PPC's mining operation, when the mine pit would be closest to Moyer Springs. The largest amount of pit seepage inflow and the largest depletion in springflow would occur during these same periods (Phillips Petroleum Company, 1982-86). During years 3 through 7, PPC's average mine pit water discharge to Dry Fork Little Powder River would be about 465 gal/min or 749 acre-feet/yr. During years 15 through 20, PPC's average mine pit water discharge to Dry Fork Little Powder River would be about 580 gal/min or 935 acre-feet/yr. Over this latter period, mine pit water discharge would more than offset the depletion in flow from Moyer Springs Creek (99 gal/min or 159 acre-feet/yr) that would be attributable to mining (580 gal/min -99 gal/min = 481 gal/min or 1.1 ft^3/s excess). Therefore, the maximum reductions in average annual flows in Dry Fork Little Powder River and the Little Powder River itself that OSMRE calculates would be attributable to reducing the flow of Moyer Springs may, in fact, never actually occur. However, the reduction in flow in Moyer Springs Creek attributable to reducing the flow of the springs would occur in any case because more pit water would be discharged into Dry Fork, which is downstream from the creek.

At the same time, the amount of excess discharge should not increase flooding potential or excessively erode the stream channel. PPC calculated that the addition of 2 ft^3/s to Dry Fork Little Powder River from the proposed Dry Fork mine would increase stream velocity from 1.19 ft/s to 1.51 ft/s, which rate is still in the nonerosive range (Phillips Petroleum Company, 1982-86); in consequence, pit pumpage should not adversely affect the stream channel of Dry Fork Little Powder River.

The impact of depleting the flow of Moyer Springs would be greater on low flows of the Dry Fork and of the Little Powder River than on average annual flows, because the springflow constitutes a larger proportion of the base flow. Low flows at gaging station No. 06324970 (Little Powder River above Dry Creek near Weston, Wyoming) are only 0.01 ft^3/s, suggesting that, under low-flow conditions, water from Moyer Springs is depleted by evaporation before it reaches this station. Thus, under low-flow conditions, depletion of Moyer Springs may affect use of surface flows only in the immediate downstream vicinity of the spring.

Livestock watering and subirrigation of forage are the downstream uses of water that would be most affected by mining depleting seasonal low flows. The magnitude of the effect is not known; however, assuming that forage vegetation downstream from the proposed life-of-mine area is acclimated to its current site and that is would not be abused through overuse, OSMRE estimates this vegetation could withstand reduced moisture levels for two seasons. Whereas the yield of the vegetation may be reduced over the short term; over the long term overall yield should not be reduced. No danger exists of eradicating the vegetation. The most probable impact on livestock of mining depleting seasonal low flows would be that ranchers would have to provide livestock alternative water sources earlier in the season than usual. The net effect of depleted low flows would be that, during the years of maximum depletion, the number of animal unit months (AUM's) that a given grazing unit would support may be reduced. However, given the variation in climate near Gillette, a variation in number of AUM's per grazing unit is common.

Reducing downstream peak discharges could reduce the quantities of water available to be diverted for flood irrigation. The primary means by which peak discharges would be reduced would be sediment ponds, which, in addition to storing sediment, reduce peak flow rates. Therefore, sediment ponds could have a considerable effect on the use of water for flood irrigation. Depleting the flow of Moyer Springs would have little effect on the availability of water for flood irrigation, because Moyer Springs flow contributes very little to peak discharges. The extent to which sediment ponds would reduce peak discharges is difficult to assess but would probably be of the same magnitude as what OSMRE estimates would be the reduction in volume of flow at the mouth of the Little Powder River, which is less than 5 percent. The actual reduction would be dependent on a number of factors, including the total capacities of the ponds and their specific spillway designs. Because no surface-water rights exist between the proposed life-of-mine area and the mouth of Rawhide Creek (Wyoming Department of Environmental Quality, 1985, p. 29), the impact on downstream water users of reducing peak discharges should be minimal.

In accordance with Wyoming law (W.S. 35-11-415(b)(xii)), PPC and other mine operators have committed to replacing the water supply of any property owner who obtains all or part of his supply of water for agricultural use from a surface source, where the supply has been adversely affected by surface coal mining activities.

The impact on downstream land and water use of mining the proposed Dry Fork mine has the potential to be moderate over the short term, whereas the impact of mining the eight mines has the potential to be significant over the short term, primarily because mining would reduce the flow of Moyer Springs. The impact of mining the eight mines, including the proposed Dry Fork mine, would become negligible over the long term as the impact to Moyer Springs were reduced. Because the potential impact on downstream land and water uses would be mitigated by the mines' compliance with the provisions of Wyoming law administered by Wyoming DEQ, OSMRE concludes that this impact would be negligible over both the short and long terms.

f. Impacts of a decrease in the flow of Moyer Springs, attributable to mining north and east of Gillette, on the value of water rights dependent on the springs

The State of Wyoming enforces a comprehensive water code relating to water rights in the State, whereby any party filing to secure water rights must receive a

permit granting such rights from the State Engineer. The final adjudication of this permit rests with the State Board of Control. The majority of existing Wyoming water rights have been obtained through this permit and adjudication system. After an applicant for water rights obtains a permit from the State Engineer, he must establish his water right by applying the water to beneficial use in accordance with the terms of the permit; he must then submit a proof of appropriation to the State Board of Control. On receipt of such proof, the board initiates adjudication procedures in accordance with regulations. Unadjudicated permits are generally amended or corrected by petition to the State Engineer. Once a water right has been adjudicated, it can only be changed or modified by the State Board of Control. A permit to appropriate water authorizes its holder to make use of water as stated in the permit. However, a water right is established only when the water it authorizes for use is actually beneficially used; a water right is publically recognized and specifically defined when it is adjudicated by the State Board of Control.

In many cases, ownership of land with an adjudicated water right (which has not been previously transferred) provides a substantial legal right to use that water for its stated beneficial purpose. The "value" of a given water right is primarily determined by the reliability of the water supply derived from it, based both on physical factors (the amount of water physically available) and on legal factors (the seniority of the appropriation, its ranking in the preferred-use system, and the extent to which it can accommodate a change of water use within this preferred-use system).

The extent to which depleting the flow of Moyer Springs would affect the value of water rights dependent on the springs is difficult to determine, because Wyoming law relating to water rights is so complex. Any allegation that a mine had adversely affected the value of a water right would likely have to be adjudicated by the Board of Control, or through the courts, on the basis of seniority of appropriation, allowed use of the water in the permit, amount of appropriation and historic use of the allowed appropriation, the status of adjudication on an appropriation, the potential for a pervious transfer of a water right, potential competing uses with a higher ranking preferred use, the potential need for a petition to change water uses, and other legal/institutional factors. A specific analysis of the extent to which mining would affect the value of water rights is much beyond the scope of this EIS. However, it is clear that any uncertainties or disputes over water rights affected by mining could be handled through established Wyoming procedures.

In addition to these laws administered by the State Engineer and the State Board of Control, the State of Wyoming, through Wyoming DEQ, administers a law (W.S. 35-11-415(b)(xii)) requiring any applicant for a permit to mine coal whose surface coal mining operations would adversely affect the water supply of any owner of interest in real property, who obtains all or part of his supply of water for domestic, agricultural, industrial, or other legitimate use from an underground or surface source, to replace that water supply. PPC and the other mine operators have committed to replacing with water of an equivalent quantity and quality the surface and/or ground water of any holder whose water source is contaminated, diminished, or interrupted by mining. Such replacement could be effected by developing known aquifers beneath the coal underlying the life-of-mine areas at depths of less than 1,000 feet. Thus, given this commitment, it is probable that no dispute over water rights affected by mining would arise.

OSMRE concludes that the temporary impact to downstream water rights from the eight mines, resulting from mining reducing the flow of Moyer Springs, would be mitigated by the mines' compliance with the provisions of Wyoming law administered by Wyoming DEQ. In consequence, this impact would be negligible over both the short and long terms.

6. Vegetation

a. Impacts of flow reductions in Moyer Springs Creek, attributable to mining north and east of Gillette, on (1) wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek and (2) wetlands and irrigated agricultural lands adjacent to the Little Powder River

Most of the 55 acres of wetland vegetation that surround Moyer Springs and Moyer Springs Creek are located within 100 feet of the springs and creek. Wyoming DEQ regulation (Chapter IV, Section 3, Wyoming DEQ, Land Quality Division Rules and Regulations) requires mine operators to maintain 100-foot buffer zones around perennial streams; in accordance with this regulation, PPC would maintain a 100-foot undisturbed buffer zone along Moyer Springs and Moyer Springs Creek; maintaining such a buffer zone would in part protect this wetland vegetation. However, OSMRE predicts that mining would reduce the flow of Moyer Springs Creek by a maximum of 22 percent over the short term. In consequence, small areas of saturated soils adjacent to the springs and Moyer Springs Creek could be dewatered, slightly decreasing the acreage available to support wetland vegetation. These reductions should be offset by proposed stream channel improvements and additional plantings of adapted woody species in the Moyer Springs Creek buffer zone. (See section D.5 of appendix A.) Increased wetland quality on the remaining acreage should result.

Moyer Springs Creek drains into Dry Fork Little Powder River, which in turn drains into the Little Powder River north of the proposed Dry Fork life-of-mine area. The reduction in flow of the Little Powder River resulting from reducing the flow of Moyer Springs would be less than 2 percent over the short term (table IV-3). Therefore, the proposed Dry Fork mine would have very little impact on wetlands and agricultural lands along the Little Powder River.

OSMRE concludes that the impact of mining on wetland vegetation adjacent to Moyer Springs Creek would be minor over the short term; the impact on wetland vegetation and irrigated agricultural lands adjacent to the Little Powder River would be negligible over the short term.

b. Impacts of the proposed Dry Fork mine on bottomland vegetation within the proposed life-of-mine area

PPC would mine approximately 216 of the total 273 acres of bottomland located in Dry Fork Little Powder River, East Draw, West Draw, North Draw, Marshall Draw, and Dry Draw, all within the proposed Dry Fork life-of-mine area. (Note that these 216 acres of bottomland are different from the 55 acres of wetland that surround Moyer Springs and Moyer Springs Creek.) The types and acreages of bottomland that would be mined and the vegetation they support are as follows: 6.4 acres of natural flood-irrigated land; 38.2 acres of subirrigated land; and 165 acres of dry bottomland, of which 27 acres have a potential for artificial flood irrigation.

During mining, PPC would diminish flow in the hydrologic system that supports vegetation on natural-flood-irrigated and subirrigated lands. However, during and following reclamation, PPC would restore the hydrologic system and with it 24.6 acres of natural-flood-irrigated land and 62.8 acres of subirrigated land. Thus, reclamation would increase the amount of the natural flood-irrigated type in the proposed life-of-mine area by 18.2 acres over its premining acreage; reclamation would increase the subirrigated type by 24.6 acres. If additional study identifies any of the original wet bottomland acreage to have potential wetland values and OSMRE and Wyoming DEQ determine that acreage to be important to the vegetative and wildlife diversity of the area (see condition No. 9, section A.1 of chapter II), they would be fully replaced during postmining reclamation activities.

Following mining and reclamation, approximately 101.6 acres of dry bottomland would remain, of which approximately 99 acres would be artificially flood irrigated. Thus, reclamation would increase the amount of dry bottomland having a potential for artificial flood irrigation in the proposed life-of-mine area by 72 acres over its premining acreage.

Although surface coal mining operations would drastically disturb 216 acres of bottomland in the proposed Dry Fork life-of-mine area, this disturbance would not constitute a major impact to the region, because the bottomland area is not uncommon and now receives only limited livestock grazing and wildlife use. Any important wetland acreage that may be identified would be replaced. These uses would be curtailed during mining but fully restored following mining. OSMRE concludes that the impact of the proposed mine on bottomland vegetation within the proposed life-of-mine area would be minor over the short term and negligible over the long term.

7. Wildlife

a. Impacts on the brook trout population in Moyer Springs Creek of flow reductions in Moyer Springs attributable to mining north and east of Gillette

Whereas mining the proposed Dry Fork mine would not physically disturb Moyer Springs Creek and its associated riparian vegetation, it would reduce flow within the creek. OSMRE predicts that the proposed mine alone would reduce the flow in Moyer Springs Creek by a maximum of approximately 17 percent. (Together, the proposed mine and the seven other mines north and east of Gillette would reduce flow in the creek by approximately 22 percent.) The first major reduction in flow would occur in the fourth year of mining the proposed Dry Fork mine; a second, larger reduction would occur in the fifteenth year of mining. These two periods of the largest reductions in flow would coincide with times when mining pits at the proposed mine were closest to Moyer Springs. By the end of the life of the proposed Dry Fork mine (the 34th year of mining and reclamation), springflow would be about 95 percent of premining flow. Flow may remain somewhat reduced for as long as 200 years after mining had been completed. At maximum flow reduction, mining would have reduced the average depth of Moyer Springs Creek by an estimated 0.8 to 0.9 inches. Trout can accommodate seasonal flow reductions amounting to as much as 60 to 70 percent; however, the flow from Moyer Springs into Moyer Springs Creek is relatively low but constant (on the average, 0.89 ft^3/s). Therefore, the trout in Moyer Springs Creek are more vulnerable than trout in streams that can accommodate dramatic flow reductions.

PPC's monitoring data indicate that, at present, the maximum reduction in flow amounts to about 20 percent for a few month period in late summer and fall. A reduction in flow resulting from mining would be additional to this natural fluctuation; it would occur in varying degrees at all times of the year over the entire 34-year life of the proposed Dry Fork mine.

Mining-induced reductions in flow would have several adverse effects on brook trout survival and productivity. First, flow reduction would decrease stream depth; in consequence, variations in temperature of water in the stream would become greater. PPC proposes to mitigate this effect by planting vegetation along the creek to provide additional shade for the creek during the warmer months of the year (appendix A). The plantings would reduce the level of direct solar radiation reaching the creek and thereby reduce evaporation and increases in temperature. They would also provide additional habitat for insects that, throughout their life cycle, would serve as food for trout. In addition, plant parts falling into the creek would constitute organic matter for the invertebrate community in the creek to use as food and shelter. PPC also found that decreasing creek flow would not affect oxygen concentrations in the creek because the reduction in turbulence would be offset by the reduction in volume of streamflow to be aerated.

Second, flow reduction would occasionally eliminate riffle areas where water is normally shallow; it would eliminate riffle areas that are intermittently dry for even longer periods. Eliminating riffle areas would (1) restrict fish movement and access to needed cover and food and (2) reduce the abundance and diversity of food. (Riffle areas are usually highly productive of invertebrates, some of which may not be adapted to longer periods of being dry.)

Finally, flow reduction would reduce the extent and quality of habitat suitable for spawning and adversely affect flow conditions necessary for trout eggs to hatch.

By implementing its proposed riparian planting along Moyer Springs Creek, PPC could offset any increase in temperature resulting from reduced flows in the creek. However, reduced flows in the creek from the eight mines would adversely affect the brook trout population by restricting trout access to cover and food, reducing the abundance and diversity of food, and reducing the extent and quality of spawning habitats. Maintaining the low flow of Moyer Springs Creek at near its current level is crucial to maintaining the brook trout population there. If flow were reduced beyond the extent OSMRE predicts it would be, the ability of the brook trout population in Moyer Springs Creek to maintain itself would be jeopardized. OSMRE concludes that the impacts of flow reductions in Moyer Springs, attributable to the eight mines including the proposed Dry Fork mine, on the brook trout population in Moyer Springs Creek has the potential to become significant over the short term but would be minor over the long term.

b. Impacts on the brook trout population of Moyer Springs Creek from increased fishing pressure attributable to mining north and east of Gillette

Facilities construction and active mining and reclamation activities at the proposed Dry Fork mine and at mines adjacent to it would bring increased numbers of people onto the proposed Dry Fork life-of-mine area. As these people spread the word about brook trout inhabiting Moyer Springs Creek, both legal and illegal

fishing in the creek would increase. Because the extent of brook trout habitat in the stream is limited, because the stream is narrow, and because the part of the stream that supports brook trout is relatively short, fishermen could easily overfish the stream and so substantially reduce its brook trout population. Uncontrolled fishing would adversely affect the brook trout population and complicate efforts to measure the impact of springflow reduction on it.

OSMRE concludes that the impacts on the brook trout population of Moyer Springs Creek of increased fishing pressure, attributable principally to the proposed Dry Fork mine but also to the seven other mines north and east of Gillette, would be significant over both the short and long terms.

c. Impacts to raptors of the loss, attributable to mining north and east of Gillette, of nesting sites and of habitat that supports prey species

Mining and related activities at the eight mines north and east of Gillette would affect a total of 30,424 acres of existing and potential raptor habitat in the eight life-of-mine areas. Scoria/break habitat disturbed by mining would be permanently lost. Species, such as ferruginous hawks, nesting in this habitat would be forced to permanently relocate. Habitat for species, such as red-tailed hawks, nesting in trees would not be permanently lost but it would take a long time to restore. Specifically, the loss of cottonwood trees along Dry Fork Little Powder River would in time be mitigated by the planting of cottonwood trees on reclaimed lands, but these trees would have to survive many years before they would be of sufficient size to support raptor nests.

In accordance with the terms of their permits, each year during the lives of the eight mines the permittees of the mines would inspect lands to be disturbed in the following year. Should any permittee discover previously unreported raptor nests, it would consult with USFWS and develop specific measures to mitigate impacts to the nests. Although this procedure would minimize impacts to nesting raptors, some uncontrolled disturbance of them, as well as some destruction of their nests, could still occur. In consequences, species productivity could be reduced.

Habitat supporting prey for raptors that would be mined in the eight life-of-mine areas could not support prey populations until it had been reclaimed. Reducing prey populations would adversely affect raptor populations dependent upon them for food. Also, reclaimed lands would initially lack topographic and vegetation diversity beneficial to prey species. In consequence, reclaimed lands would not initially support prey species as diverse as those that unmined lands currently support. Mining the eight mines would disturb a relatively small portion of the total habitat needed by golden eagles, a species with a large home range, to successfully raise young. However, mining could disturb the majority or all of the habitat needed by other raptors, whose home ranges are much smaller, to successfully raise young. Whereas the number of raptors nesting on the eight life-of-mine areas changes from year to year, current information indicates that a total of seven golden eagle pairs and six pairs of other raptors would be affected by mining and related activities at the eight mines.

OSMRE concludes that the impacts on raptors of the loss, attributable to the eight mines including the proposed Dry Fork mine, of nesting sites and of habitat that supports prey species would be moderate over the short term and minor over

the long term. The impacts would be greater in proportion as they occurred across larger portions of a given raptor pair's home range.

d. Impacts of the proposed Dry Fork mine on golden eagles protected by the Bald Eagle Protection Act, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.

In 1982, USFWS moved an active golden eagle nest from a cottonwood tree along Dry Fork Little Powder River in sec. 25 to a nesting platform outside the area of proposed disturbance in sec. 19, T. 51 N., R. 71 W. Relocating this nest does not appear to have affected the pair's reproductive success, because it successfully raised young at the relocation site in 1983 and 1985 (Art Anderson, U.S. Fish and Wildlife Service, oral communication, January 1986). The pair did not successfully raise young at the site in 1984, but several other raptors in the region were also not successful in raising young, apparently because prey species were at a low point in their population cycles. The pair of golden eagles from the Dry Fork property could be adversely affected if the nesting platform were to become unusable before cottonwoods of suitable size had grown on the reclaimed minesite. At present, PPC is not required to maintain the nesting platform.

Mining activities at the proposed Dry Fork mine would disturb habitat supporting prey species for these eagles. At its maximum extent, this disturbance would affect approximately 1,273 acres of the pair's 12,800-acre home range. Over the long term, the topography and vegetation of reclaimed lands would be less diverse, reducing the suitability of these lands for some prey species such as rabbits. Cottonwood trees planted on reclaimed areas would eventually provide suitable sites for eagle perching and nesting.

OSMRE concludes that the impacts of the proposed Dry Fork mine on the pair of golden eagles whose nest USFWS moved from the proposed life-of-mine area has the potential to become significant over the short term but would be moderate over the long term.

e. Impacts of mining north and east of Gillette on migratory birds of high Federal interest, including ferruginous hawks, burrowing owls, and mountain plovers

AMAX Coal Company and Kerr-McGee Coal Corporation have identified ferruginous hawk nests on or adjacent to the Eagle Butte and proposed East Gillette Federal life-of-mine areas; none of the permittees of the eight mines north and east of Gillette, including the proposed Dry Fork mine, has located nests of these species on or adjacent to the other six of the eight life-of-mine areas. None of the permittees of the eight mines has located burrowing owl or mountain plover nests. The eight permittee's annual wildlife monitoring efforts could detect previously unreported nests of migratory birds of high Federal interest within or adjacent to the 30,424 acres that constitute their life-of-mine areas. Should the operators locate such nests, they would consult with USFWS to develop specific measures to mitigate impacts to the birds using the nests. (Note, however, that the search for these species' nests would be only one component of the overall monitoring plan for several species of wildlife. In consequence, the monitoring efforts may (1) be neither specific enough nor conducted during the correct time of the year to accurately determine the location of the nests and (2) not accurately report the number of nests on or adjacent to the life-of-mine areas.) Because the knowledge of the status of migratory birds of high Federal interest within the eight

life-of-mine areas is limited, and because the populations of these migratory birds is already declining, the potential for mining adversely affecting the birds is great.

The eight mines would disturb potential nesting sites and habitat used for feeding by migratory birds of high Federal interest. Reclamation would produce habitats with less topographic and vegetation diversity, both of which are important to ferruginous hawks and burrowing owls. Ferruginous hawks favor scoria/break habitat for nesting. And whereas the eight permittees could construct rock piles to simulate many of the features of scoria/breaks habitat, ferruginous hawks have never been observed using rockpiles for nesting. Thus, simulated scoria/break habitat may prove unsatisfactory to nesting ferruginous hawks. Burrows for burrowing owls to live and nest in would not be available on reclaimed land until ground squirrels and other fossorial species had successfully colonized the reclaimed landscape. The flatter topography of reclaimed grasslands would restore the potential for mountain plover nesting.

OSMRE concludes that the impact of the proposed Dry Fork mine on burrowing owls and ferruginous hawks would be moderate over the short term and minor over the long term. The impact on mountain plovers would be minor over the short term and negligible over the long term. The impact of the eight mines on all three species of migratory birds of high Federal interest has the potential to become significant over both the short and long terms.

f. Impacts of the proposed Dry Fork mine on the pair of red-tailed hawks nesting in sec. 25, T. 51 N., R. 72 W.

Mining operations at the proposed Dry Fork mine would destroy a red-tailed hawk nest site in sec. 25. At least one breeding season prior to destroying this nest site, PPC would consult with USFWS to develop a specific mitigation plan, according to the terms of which it would relocate the hawk nest to a suitable site outside the proposed disturbance area prior to destroying the current nest site.

Portions of the habitat supporting prey for the hawks would be sequentially disturbed and reclaimed. Reclaimed lands would not support the premining diversity of prey, because they would have less topographic and vegetation diversity. The abundance of prey species associated with mature shrubs would be reduced until shrub growth and distribution approached premining levels. Cottonwood trees planted by PPC would have to survive many years to be suitable nest sites for red-tailed hawks.

OSMRE concludes that the impacts of the proposed Dry Fork mine on the pair of red-tailed hawks nesting in the proposed life-of-mine area would be moderate over the short term and minor over the long term.

g. Impacts of mining north and east of Gillette on pronghorn of the Gillette and North Black Hills Herd units

Mining and related activities at the eight mines north and east of Gillette would disturb approximately 1 percent of the occupied pronghorn habitat (or 21,744 acres) within the Gillette and North Black Hills Herd units delineated by Wyoming GFD (which have a total acreage of 2,118,400 acres). Wyoming GFD has classified all the occupied pronghorn habitat that the eight mines would disturb as yearlong habitat; Wyoming GFD has classified a portion of the habitat as winter range.

Pronghorn have generally adapted themselves to routine, nonthreatening activities common to mining and reclamation operations. However, the pronghorn population near Gillette is already above Wyoming GFD's population management objective for it. In consequence, even if pronghorn could adapt to mining, disturbing their habitat would displace them from the eight life-of-mine areas and cause them to compete among themselves and with other pronghorn for limited food and shelter. Thus, consumption of range vegetation, which is already being consumed at above-normal levels, would increase. In addition, mining would irreversibly alter some topographic features on the winter range in the life-of-mine areas that are important as shelter for pronghorn, enabling them to endure winter storms; mine facilities, including fences, could alter pronghorn access to preferred winter and yearlong habitats. The operators of the eight mines would revegetate the life-of-mine areas in part with shrub species of high nutritional value to pronghorn, especially in winter. However, the distribution and extent of of these shrub species on reclaimed areas would be reduced from premining distribution and extent. Traditionally, some shrub species, such as big sagebrush, have been difficult to establish and have taken many years to approach premining productivity.

OSMRE concludes that the impacts of the eight mines, including the proposed Dry Fork mine, on pronghorn of the Gillette and North Black Hills Herd units would be moderate over both the short and long terms.

h. Impacts of mining north and east of Gillette on mule deer of the Powder River Herd unit

Mining the eight mines north and east of Gillette would disturb only a small part of the occupied mule deer habitat within the Powder River Herd unit delineated by Wyoming GFD. In general, mule deer appear to be quite tolerant of routine, nonthreatening human activities associated with mining and reclamation. In fact, some permit areas, where hunting and off-road vehicle use are restricted, afford deer refuge from such disturbances. Mule deer tend to use recently reclaimed lands seasonally, especially when grasslands are greening up in spring. The topography of and vegetation on land reclaimed using standard reclamation practices is generally less diverse than the topography and vegetation of the land before mining. In addition, reclaiming using these practices does not quickly make available shrub species important to mule deer. Once they are available, these species are commonly reduced in extent, distribution, and productivity. Deer displaced by mining activities at the eight mines would be forced off portions of the eight life-of-mine areas to compete among themselves and with other mule deer for a smaller amount of habitat. Because mule deer habitat is limited and occupied near Gillette, the effect of the displacement would be somewhat greater than if habitat were less limited and unoccupied.

OSMRE concludes that the impacts of the eight mines, including the proposed Dry Fork mine, on mule deer of the Powder River herd unit would be minor over both the short and long terms.

i. Impacts of mining north and east of Gillette on sage grouse of Management Area 43

Mining and related activities at the eight mines north and east of Gillette would disturb a portion of the habitat used by sage grouse within Management Area 43, delineated by Wyoming GFD, for brood rearing, wintering, and normal

maintenance. The production, distribution, and extent of sagebrush habitat necessary for winter survival would be reduced in the eight life-of-mine areas after mining and reclamation had been completed there. Forb diversity valuable to sage grouse broods would also be reduced. Sage grouse strutting grounds would not be affected by the mining or related activities.

OSMRE concludes that the impacts of the eight mines, including the proposed Dry Fork mine, on the sage grouse of Management Area 43 would be moderate over both the short and long terms.

j. Secondary impacts on wildlife of the loss of habitat related to population growth and the increased incidence of road kills, general harassment, and poaching, all attributable to mining north and east of Gillette

Beyond their direct effects, mining and related activities at the eight mines north and east of Gillette would generate indirect effects on wildlife. The mining industry has attracted people to Gillette and Campbell County both to work at the many mines there and to provide support services for mine employees. Since 1970, the population of the Gillette area has increased nearly threefold (Richardson Associates, 1985). With the eight mines, the population of Campbell County is projected to peak in the year 1994; from 1985 to 1994, the county's population could increase by 6 percent as a result of the Dry Fork mine and by as much as 29 percent as a result of all eight mines (Richardson Associates, 1985). As a consequence of this population, additional houses, shops, and other facilities, the construction of which removes habitat from wildlife use, have been and will continue to be built.

Recreation in Wyoming is outdoor-oriented; in consequence, increased human population in Wyoming generally results in an increase in hunting, fishing, snowmobiling, and off-road vehicle use, all of which compound the adverse impacts of habitat disturbance and alteration by mining. Likewise, increased vehicle traffic transporting this increased population is responsible for more wildlife/vehicle collisions and so for increased wildlife mortality. Increased outdoor recreation results in an increase in harassment and poaching of wildlife. Wyoming GFD data show that, between 1970 and 1979, the number of wildlife-related arrests increased 61 percent (Wyoming Department of Environmental Quality, 1983).

OSMRE concludes that the secondary impacts on wildlife of the loss of habitat related to population growth and the increased incidence of road kills, general harassment, and poaching, all attributable to the Dry Fork mine, would be minor over both the short and long terms. The impacts attributable to the eight mines has the potential to become significant over the short term but would be moderate over the long term.

8. Socioeconomics

a. Impacts of mining on employment, personal income, and population in Gillette and Campbell County

Based on the assumptions presented in the "Assumptions of the Impact Analysis" section of this chapter (i.e., continued operation of all existing mines within the county at 1984 levels and development of those proposed mines, including the proposed Dry Fork mine), employment, personal income, and

population in Campbell County could be anticipated to increase steadily into the mid- to late 1990's, remain relatively stable through 2005, and then begin to decline as the various coal mines deplete the available coal and begin to cease operations.

Peak mining employment during this period could reach as high as 8,317 employees (i.e., 66.4 percent greater than mining employment in 1984; table III-6), with annual increase as high as 4.4 percent (Richardson Associates, 1985). Total county employment should parallel mining employment but at a slower pace, potentially reaching as high as 23,203 employees (i.e., 35.6 percent greater than 1984; Richardson Associates, 1985; table III-6).

The proposed Dry Fork mine would be responsible for increasing mining employment in Campbell County by 313 employees in the first 10 years of operation (table I-2). Over this same period, it could increase total employment in Campbell County by as many as 614 employees (Richardson Associates, 1985). The peak effect of the proposed mine on employment in the county would occur in its 17th year, when it would account for 513 additional mining jobs (table I-2) and as many as 976 total jobs in Campbell County (Richardson Associates, 1985). These jobs could constitute as much as 6.1 percent of the county's potential mining employment and 3.9 percent of the county's potential total employment. After the 22d year of coal removal at the proposed mine, employment declines would parallel the decrease in overall coal production and employment in the county (table I-2).

Total personal income in Campbell County could reach $710.3 million by 2005, a 53.2-percent increase over the estimated total personal income in 1984 (Richardson Associates, 1985). The proposed Dry Fork mine could be expected to contribute 13.5 percent of that increase (i.e., $30.1 million; Richardson Associates, 1985).

The peak population in Campbell County could occur as early as 1994 (approximate) and could reach 46,855 people (i.e., 34.5 percent greater than the estimated 1984 population; Richardson Associates, 1985; table III-8), whereas the peak population in Gillette would occur around 2005 (approximate) with as many as 30,950 people (i.e., 52.8 percent greater than the estimated 1984 population; Richardson Associates, 1985; table III-8). The population associated with the proposed mine could constitute as much as 16.1 percent (1,948 people) of the county's potential increase and as much as 12.1 percent (1,297 people) of Gillette's potential increase.

OSMRE concludes that the impact on employment, personal income, and population in Gillette and Campbell County from mining would be moderate through 2005 (approximate), when the peak effect would be anticipated to occur ((i.e., short term). After 2005, employment at mines in Campbell County would decline, causing an overall decline in employment (and, in consequence, personal income and population) in Gillette and the county. Therefore, OSMRE further concludes that the impact on current employment, personal income, and population in Gillette and Campbell County from mining has the potential to become significant beyond the year 2005 (approximate) because of the loss of income and economic opportunity (i.e., short term and long term).

OSMRE concludes that the proposed Dry Fork mine would have a minor impact on these socioeconomic variables over both the short term and the long term, because it is only one of many economic development projects that could contribute to overall employment, personal income, and population.

b. Impacts of mining on housing in Gillette and Campbell County, including impacts to property values in the Garner Lake housing development

Housing needs in Gillette and Campbell County are closely associated with projections for population and employment and would be anticipated to follow the same general pattern of increase and decrease over the next 20 to 30 years that was discussed under the "Impacts of mining on employment, personal income, and population in Gillette and Campbell County" impact topic, above. The surplus of housing units (chapter III) is likely to dwindle, with the need for housing possible peaking as early as 1994 (approximate). That year, persons living in Campbell County could require as many as 16,039 housing units, 79.1 percent of which could be required in the city of Gillette (Richardson Associates, 1985). This would be a 22.6-percent increase in countywide housing units over those estimated to be available in December 1985 (chapter III). The proposed Dry Fork mine would eventually require as many as 666 housing units (603 units within the city of Gillette), when its workforce peaks in the 17th year of its operation, but this would likely occur after the overall housing requirement has peaked and few additional units would be required (Richardson Associates, 1985).

OSMRE determined the probable impact of mining north and east of Gillette on nearby residential areas (specifically, on the Garner Lake housing development, located in sec. 18, T. 50 N., R. 71 W., approximately 1 mile northeast of the Gillette city limits and approximately 2 miles south of the proposed Dry Fork life-of-mine area) on the basis of (1) the proximity of these areas to existing and future mining activity, (2) the anticipated pattern of other nearby development, (3) the potential for annexation of the areas into the city limits of Gillette, and (4) values of property in the areas compared to values of property elsewhere in and around Gillette.

Several other mines located proximate to nearby residential areas (e.g., the Clovis Point, the proposed East Gillette Federal, and the Fort Union mines) are operating or may be operating before the proposed Dry Fork mine would commence operation; therefore, the impact of mining on property values would have already occurred and should not be altered by the proposed Dry Fork mine.

Existing mining plans for mines north and east of Gillette project the eventual disturbance by mining of land in a 270° arc around the Garner Lake housing development. Land not identified for surface mining proximate to the Garner Lake housing development has been identified by Gillette for commercial/industrial development or single-family home development. Currently, no plans exist to annex the Garner Lake housing development into Gillette. This circumstance alone could suppress property values in the development, which could not expect access to city provided services, such as sewer and water. In consequence, property values within the Garner Lake housing development could fall with or without the proposed Dry Fork mine.

Available data on types (quality, size, and price) of housing preferred by potential buyers in the vicinity of Gillette indicate that the Garner Lake housing

development may not be as desirable to buyers as are developments located to the south and southwest of Gillette. The demand for property within the Garner Lake housing development and, hence, the value of housing development property, would not change to any large degree as a result of mining north and east of Gillette.

OSMRE concludes that the impact of the eight mines on housing requirements in Gillette and Campbell County through the year 2005 (approximate) would be minor over both the short term and the long term. OSMRE also concludes that the impacts of these mines on property values in the Garner Lake housing development would be minor over both the short term and the long term.

c. Impacts of mining on the public sector fiscal conditions of Gillette, Campbell County, and the Campbell County School District

OSMRE projected future public sector fiscal conditions in Gillette, Campbell County, and the Campbell County School District using economic base assumptions listed in the "Assumptions of the Impact Analysis" section of this chapter.

In general, requirements for extensive capital improvement expenditures should decrease over the coming years throughout Gillette, Campbell County, and the Campbell County School District. In consequence, revenues should be adequate for all these jurisdictions. Revenues and expenditures would parallel population growth in the county, with all of these jurisdictions having positive net fiscal balances throughout the period (Richardson Associates, 1985). The proposed Dry Fork mine alone should have either no net fiscal effect or a positive net fiscal effect on Gillette, Campbell County, and the Campbell County School District (Richardson Associates, 1985). Any negative net fiscal effect of the proposed mine should be more than offset by the revenues the mine generates (Richardson Associates, 1985).

OSMRE concludes that the impact of mining the eight mines north and east of Gillette on the public sector fiscal conditions of Gillette, Campbell County, and the Campbell County School District would be minor over both the short and long terms.

d. Impacts of mining on social well-being in Gillette and Campbell County

The social well-being of an individual or community is typically measured with reference to that individual's or community's ability to maintain a preferred quality of life, including adequate employment opportunities, access to public social services and health care facilities, and access to esthetic resources, such as recreational areas and programs. OSMRE projects that if population, employment opportunities, and public fiscal conditions remain relatively stable in Gillette and Campbell County past the year 2000, the quality of life indicators should also remain stable. The impact of the proposed Dry Fork mine on social well-being would be positive, in that the mine would at most (in its 17th year) offer mining employment opportunities to over 500 people in Gillette and total employment opportunities to 976 people in Campbell County.

After a number of mining operations, including the proposed Dry Fork mine, begin to close, population and employment in the city and county would begin to decline.

Currently, national and regional economic downturns have resulted in increased unemployment and uncertainty regarding future coal development in Campbell County. Should this downturn continue and new coal development (such as the proposed Dry Fork mine) be further postponed, the quality of life in Campbell County could decline.

OSMRE concludes that the impact of the eight mines north and east of Gillette, including the proposed Dry Fork mine, on social well-being in Gillette and Campbell County would be minor and positive until area mines begin to close (i.e., short term). After they close (i.e., long term), the impact of mining on social well-being would be minor and negative.

9. Recreation

a. Impacts of mining on public recreation facilities and services in Gillette, Campbell County, and Keyhole State Park

Additional demand for recreation facilities in Gillette and Campbell County would be generated by increases in population. The peak need could occur as early as 1994 (approximate), when population peaks could be reached. (See section B.8.a of this chapter.) Both Gillette and Campbell County already have control over sufficient land for parks and recreation needs and would be expected to place future emphasis on development of this controlled acreage into specific recreation uses.

Gillette and Campbell County residents would continue to be attracted to other regional recreational resources involving camping, hunting, and similar activities. The most important nearby major recreational resource located in the region likely to be affected by increasing population is Keyhole State Park. Campbell County residents should continue to account for at least the current 40.4 percent of the use at the park in future years, which could amount to as much as 72,702 visitor days by the year 2000 (chapter III). Park facilities tend to be crowded on weekends and would be expected to be further overutilized as populations throughout Wyoming (and in Campbell County) increase (Richardson Associates, 1985).

OSMRE concludes that the impact of the eight mines north and east of Gillette, including the proposed Dry Fork mine, on public recreation facilities and services in Gillette and Campbell County would be minor over both the short term and the long term. Unless funds are secured to improve Keyhole State Park, the park could continue to be overused and unable to meet recreational demand. Persons affiliated in some respect with the eight mines could compound this overuse; therefore, the impact of the mines on the park has the potential to become significant over the short term but would be minor over the long term.

10. Transportation

a. Impacts of increased traffic, attributable to mining north and east of Gillette, on public safety and on traffic flow in and around Gillette

Increases in population could lead to increased traffic levels on the local and regional transportation networks as early as 1994 (approximate). (See section B.8.a of this chapter.) Higher traffic volumes would occur as a result of industrial service and employee travel to the various economic development projects, including the proposed Dry Fork mine, as well as secondary traffic generated by household shopping trips, etc., that are associated with the population at large. This could lead to additional congestion and delay, more traffic accidents, and increased noise and air quality problems.

Past rapid growth associated wtih energy development and trasportation planning by local, State, and Federal governments has ensured that the local transportation network is generally adequate to meet projected levels of future demand. Localized problems could still be expected to occur. With respect to development north and east of Gillette, including the proposed Dry Fork mine, concerns include additional traffic on Garner Lake Road and commuter travel through Gillette to the various minesites.

Traffic in some way associated with the proposed Dry Fork mine could make as many as 700 vehicle trips daily on Garner Lake Road as early as the mine's 10th year of operation and could continue to do so through its 22d year. Traffic associated with the proposed mine and with the proposed East Gillette Federal mine could make as many as 1,200 vehicle trips daily over Garner Lake Road during this same period (Richardson Associates, 1985). Traffic associated with all four of the mines using Garner Lake Road would increase the chances of automobile and truck accidents occurring on Garner Lake Road. Traffic associated with the Buckskin, Rawhide, and Eagle Butte mines would somewhat increase traffic over U.S. 14-16 and Wyoming 59.

Planned improvements such as the paving of Garner Lake Road to the Dry Fork minesite and the improvement of the Garner Lake Road/I-90 interchange should alleviate a majority of the potential problems. However, projected problems at the intersection of Garner Lake Road and Kluver Drive (the entrance to the Garner Lake subdivision) and across a segment of Garner Lake Road north of the Kluver Road interchange, consisting of sharp turns without adequate banking, would continue to pose hazards.

Many improvements have been made to the internal circulation route through Gillette. These improvements were designed to minimize traffic congestion in downtown Gillette and at the U.S. 14-16/Wyoming 59 intersection.

OSMRE concludes that the impact of increased traffic, attributable to the eight mines, on public safety along Garner Lake Road, U.S. 14-16 and Wyoming 59 has the potential to become significant over the short term but would be minor over the long term. The impact of increased traffic on traffic flow over the internal circulation routes through Gillette would be minor over both the short term and the long term.

b. Impacts of increased coal train traffic, attributable to mining north and east of Gillette, on public safety and automobile traffic flow at at-grade railroad highway crossings

Increased coal train traffic over the region's railroad network typically leads to traffic delays, congestion, and increased accident hazards. Impacts resulting from rail operations would be concentrated within, but not confined to, the region. Rather, they would be manifested, to a lesser degree, wherever the coal shipment goes.

Officials of communities along the Burlington-Northern main line have identified highway traffic delays at at-grade crossings as the largest problem resulting from increased train traffic (Richardson Associates, 1985). Communities that have developed around the railroad tracks are temporarily severed by passing trains if they do not have grade-separated crossings. Communities that have insufficient grade-separated crossings find that traffic levels on the ones they do have increase as motorists alter their routes to avoid blocked grade crossings. In both cases, traffic delays create an inconvenience to local residents and, more important, may delay the provision of essential community services such as police, firefighting, or medical aid.

In the area north and east of Gillette, the Buckskin, Rawhide, Eagle Butte, Fort Union, and Clovis Point mines, as well as the proposed East Gillette Federal and Dry Fork mines, would transport their coal along a Burlington-Northern railroad spur to the Burlington-Northern main line. The Wyodak mine uses the Burlington-Northern main line itself to transport coal. At full production, the seven mines using the spur would have increased train traffic along it from the 1984 level of 30 to 32 round trips per week to as many as 100 to 110 round trips per week, with the proposed Dry Fork mine generating approximately 20 percent of this total (Richardson Associates, 1985).

OSMRE concludes that the impact of the eight mines on public safety and automobile traffic flows at at-grade railroad highway crossings would be moderate over the short term and minor over the long term.

11. Cultural Resources

a. Direct and indirect impacts of mining north and east of Gillette on historic and prehistoric sites on and adjacent to the life-of-mine areas

Of the 220 cultural resource sites thus far recorded in the eight life-of-mine areas north and east of Gillette, and in the buffer zones surrounding them, approximately 14 percent are considered eligible for listing in the National Register of Historic Places. Mining activities at the eight mines would impact, either directly or indirectly, a majority of the eligible sites. No particular type of site would be any more likely to be impacted than any other. The operators of the eight mines would either avoid and preserve in-place sites that are considered eligible for nomination to the National Register of Historic Places or would implement mitigation measures that would considerably lessen the impacts to cultural resources.

Of the 24 cultural resource sites thus far recorded in the proposed Dry Fork life-of-mine area and the buffer zone surrounding it, two prehistoric sites and one

historic site are eligible for listing in the National Register of Historic Places. Mining activities at the proposed Dry Fork mine would destroy the prehistoric "campsites" but would not directly affect the historic site (the Moyer Homestead), which lies in the buffer zone. Mitigation, consisting of systematic surface collecting and representative sample excavations, has been required for the prehistoric sites. The approved mitigation would be completed well in advance of mining impacts.

Even though mining would not directly disturb the Moyer Homestead, it could indirectly affect the homestead by increasing human activity in its vicinity, thereby increasing the chances of the homestead being vandalized.

OSMRE concludes that a majority of the eligible historic and prehistoric sites on or adjacent to the eight life-of-mine areas that would or could be directly or indirectly disturbed by the eight mines are irreplaceable resources and their loss would be permanent. However, given the number and type of historic and prehistoric sites that mining could disturb, OSMRE concludes that the impact of the eight mines on cultural resources in the region would be minor.

b. Impacts of mining north and east of Gillette on undiscovered cultural resource sites, especially buried prehistoric sites in the vicinity of Moyer Springs and Moyer Springs Creek

Mining and related activities at the eight mines north and east of Gillette could destroy undiscovered cultural resource sites. Cultural resource inventories based on current technology and methodology may not have located all important sites or data within the eight life-of-mine areas and buffer zones surrounding them, because current technology and methodology allows for the investigation of only certain sites and for the collection of only part of the scientific data present at a given site. Selecting certain sites for future treatment in lieu of others may cause the loss of important cultural resources.

OSMRE would condition any mining-plan approval for PPC to mine the proposed Dry Fork life-of-mine area so as to require PPC to report any unanticipated cultural resource finds to Wyoming DEQ and OSMRE for evaluation. (See condition No. 7 in section A.1 of chapter II.) OSMRE has already conditioned the mining plan approvals issued to the permittees of the other seven mines north and east of Gillette in this manner. (Thus far in the course of mining, five cultural resource sites that had not been discovered prior to the commencement of mining have been reported in the general Powder River area.) In accordance with this condition, earth-disturbing activities cease in the area of any find until its disposition is resolved. Although conditioning mining-plan approvals in this manner does not eliminate impacts to as yet undiscovered cultural resources, it does reduce the impacts to them once they are discovered.

The probability of important undiscovered buried prehistoric sites existing on or adjacent to the eight life-of-mine areas is heightened in the vicinity of Moyer Springs and Moyer Springs Creek (proposed Dry Fork mine) and at other mines where permanent water is available or the depositional environment is such that earlier land surfaces containing archeological sites are preserved. Wyoming DEQ regulation requires mine operators to maintain 100-foot buffer zones around perennial streams; in accordance with this regulation, PPC would maintain a 100-foot buffer zone around the springs and creek. Maintaining such a buffer zone

would in part protect any undiscovered buried prehistoric sites near the springs or creek. However, mining might directly or indirectly impact as yet unlocated important cultural resource sites just outside this buffer zone.

OSMRE concludes that the impact of the eight mines on undiscovered cultural resource sites has the potential to become significant. Any impact to cultural resource sites, whether from mining or from other causes, is permanent. Unanticipated discoveries would be evaluated for importance and mitigation measures would be required as necessary.

12. Visual Resources

a. Impacts to visibility in the Gillette, Wyoming, area and at Devils Tower National Monument from increased particulate and diesel emission levels attributable to mining north and east of Gillette

Particulates and diesel emissions would constitute the principal means by which mining activities at the eight mines north and east of Gillette would degrade visibility. Particulates generated from the removal and haulage of coal and overburden, diesel emissions from the startup of vehicles, blasting, and wind erosion all contribute to haze or dust at a surface coal mine. Together, this haze and dust forms a visible plume. Because particulates and diesel emissions would be perceptible to observers from both a local and a regional perspective, OSMRE has analyzed impacts on both local and regional visibility.

For purposes of analysis, OSMRE defined the impacts to local visibility to be visual resource impacts affecting the Gillette, Wyoming, area. Visual resource impacts would be most perceptible on and immediately adjacent to active mines, where it is likely that a localized haze (known as "plume blight") would develop during poor meteorological conditions as the result of soot particles being emitted by diesel equipment operating at these mines. OSMRE used a model described by Latimer and Maxwell (1982) to perform its visibility screening analysis for the Gillette area. This model accounts for the effect of particle size distribution on both light scattering efficiency and gravitational settling. As a result, the effect of increased particulates as a percentage of visual range reduction (which would vary with wind speed and atmospheric stability) can be predicted. The model assumes an observer's line of sight would pass across plumes from all mines in a given region. This assumption is conservative because lines of sight are commonly along the ground, not elevated.

Using this model, OSMRE calculated that the eight mines north and east of Gillette would reduce the visual range in the Gillette area by 17 miles. To arrive at an estimate of the extent to which the proposed Dry Fork mine alone would reduce visual range, OSMRE divided the contribution of the proposed Dry Fork mine to particulate emissions in the mine's maximum emissions year (1995) by the total particulates that would be emitted from all eight mines north and east of Gillette during that year. Mining activities at the eight mines north and east of Gillette would reduce the visual range in the Gillette area by about 15 percent (from approximately 112 miles mean visual range to 95 miles, which results in a cumulative reduction in visual range of 17 miles). The proposed Dry Fork mine would generate approximately 12.6 percent of the particulate emissions from the eight mines; thus, it would be responsible for reducing the visual range in the Gillette area by approximately 2 miles (17 miles cumulative reduction in visual

range x 0.126 contribution to reduction of visual range by the proposed Dry Fork mine alone = 2.1 miles). Assuming that the background visual range in the Gillette area is approximately 112 miles (Latimer and Maxwell, 1982), the proposed Dry Fork mine alone would reduce the visual range in the Gillette area by approximately 2 percent (2.1 miles divided by 112 miles = 1.9 percent).

OSMRE defined the point of maximum regional visibility impact to be the most potentially sensitive air quality area in the region where reduced visibility would detract from viewer enjoyment of the area (i.e., a national monument, a national park boundary, or a national forest boundary). The closest potentially sensitive air quality area to the eight life-of-mine areas is Devils Tower National Monument, located in Wyoming approximately 44 miles east-northeast of the proposed Dry Fork mine permit area.

OSMRE used a model described in Latimer and Ireson (1980) to perform its Level 1 visibility screening analysis for Devils Tower National Monument. This model describes the effect of increased particulates as "plume contrast against the sky," "plume contrast against terrain," and "change in the sky/terrain contrast." The model assumes the most conservative (poorest) meteorological conditions for maximizing visibility reduction (extremely stable atmosphere and low wind speed) and maximum air pollution emissions from a given mine. Using the model, OSMRE calculated that, under extremely poor meteorological conditions, mining activities at the eight mines would (1) affect all three visibility parameters at the monument such that the numerical values for the parameters would remain well below the suggested Level-1 maximum of 0.10 and (2) reduce the visual range at the monument by less than 1 mile. Assuming that the background visual range at the monument is about the same as that in the Gillette area (approximately 112 miles), the eight mines would reduce the visual range at the monument by about 1 percent (1 mile divided by 112 miles = 0.9 percent). Therefore, the reduction of visibility at the monument as a result of mining activities at the eight mines would be negligible.

OSMRE concludes that the impact of the eight mines to local and regional visibility would be minor and negligible, respectively, over the short term. The impact of the mines to both local and regional visibility would be negligible over the long term.

13. The Relationship Between Local Short-Term Uses Of Man's Environment And The Maintenance And Enhancement Of Long-Term Productivity

Based on anticipated production levels, the proposed Dry Fork life-of-mine area would be committed to coal production and reclamation for 34 years. OSMRE considers the impacts of mining the proposed life-of-mine area to be short term if they would occur during these 34 years (which constitute the life of the proposed Dry Fork mine) and long term if they would persist beyond 34 years.

Removal and haulage of overburden and coal along unpaved roads and wind erosion at the Dry Fork mine would increase TSP concentration on and in the vicinity of the mine. These increased TSP concentrations, in combination with diesel emissions from equipment operating at the mine, would reduce visibility at and in the vicinity of the mine. This degradation of air quality and reduction in visibility would occur over the short term. These impacts would cease once mining and reclamation was completed.

Approximately 3.8 million bank cubic yards of scoria (32 percent of the scoria resource on the proposed permit area) would be mined and used by the mining operation over the short term. The permanent loss of this part of the scoria resource for future uses would be minor because no demand for the resource by any other party is probable. Over the short term, the proposed mine could disrupt oil production from three wells within the proposed life-of-mine area. However, over the long term, oil production from these three wells could resume with no loss of the resource.

Construction and mining would progressively disturb soils on 2,904 acres. Over the long term, productivity of the soils should return to or exceed premining productivity, because reclaimed soils should be more uniform in depth, texture, and chemical and physical composition than are premining soils.

Mining the Dry Fork property would slightly reduce the long-term hydrologic productivity of the environment. Many of the impacts of mining on the hydrologic resource would outlast the life of the mine. Mining would deplete the flow of Moyer Springs flow by less than 5 percent for several hundred years following its completion while the coal/scoria aquifer potentiometric surface recovered. After the potentiometric surface had recovered, the salinity of Moyer Springs would increase. Many of these impacts would occur in any case, even if the Dry Fork property were not mined, as the result of other mining activities north and east of Gillette; however, the magnitude of the impacts would be slightly smaller without the proposed Dry Fork mine. The proposed mine would withdraw water from a deep well completed in the Tullock Member of the Fort Union Formation, thereby drawing down water levels in the 37 wells in the formation within 31.5 miles of it. Water levels in the Tullock Member should recover quickly after the Dry Fork well stopped pumping.

During construction and operation of the proposed mine, vegetation would be lost and wildlife habitat and grazing land disturbed on 2,905 acres. Native grasses and shrubs would be planted to restore rangeland on reclaimed areas. OSMRE estimates that disturbed areas would be returned to an equivalent or better forage production capacity within several years of their initial disturbance. Long-term productivity would depend largely on range management practices.

Wildlife productivity would generally decrease over both the short and long terms on those lands affected by mining and mining-related activities. The approximate 22-percent maximum reduction in flow in Moyer Springs Creek during mining, of which a maximum of 17 percent would be attributable to the proposed Dry Fork mine alone, would reduce the quality and extent of brook trout habitat in Moyer Springs Creek. Upon completion of mining and reclamation, flows would approach their premining levels; in consequence, the capability of the creek to support brook trout would also approach its premining level. Terrestrial wildlife would use reclaimed lands, but the use by species reliant on mature shrub and trees (e.g., pronghorn and golden eagles) would not approach premining levels until many years after initiation of reclamation. The use of the area by species associated with scoria/break habitat (e.g., mule deer and ferruginous hawks) would never approach premining level, because this type of habitat would be permanently lost on mined areas.

Over the short term, the proposed Dry Fork mine would employ a labor force of over 500 persons. Expenditures related to mine construction, operation, and reclamation activities should help stabilize the economy of Gillette and Campbell

County past the year 2000. After its 17th year, employment at the proposed mine would begin to decrease, paralleling the overall decrease in mining and energy related employment in the county. The proposed mine would neither accelerate nor mitigate this trend toward decreased employment; therefore, the proposed mine would not significantly affect the long-term productivity of the socioeconomic environment in Gillette and Campbell County.

Recreational resources would be used by persons in some way affiliated with the proposed mine throughout the life of the mine. Keyhole State Park is currently overused. The demand on park facilities created by mine-related population would compound this overuse unless adequate funds are secured for needed improvements.

Over the short term, PPC's use of the Burlington-Northern railroad spur and main line would increase coal train traffic over these existing facilities. PPC would invest labor and capital in order to use the rail line, thereby aiding in maintaining the local economy. Over the long term, benefits to the local economy would diminish because the proposed mine would have ceased operation.

Over the short term, knowledge of cultural resources and past lifeways would increase because of the inventory and data collection work completed on and adjacent to the proposed Dry Fork mine. Over the long term, knowledge of resources and lifeways could decrease, because vandalism could destroy information, mining could destroy undiscovered sites, and current technology and methodology could cause researchers to overlook or find unimportant sites or data that in the future may be critical to the interpretation of past lifeways. Any impact to cultural resource sites caused in these or any other way would be permanent.

14. Irreversible and Irretrievable Commitment of Resources

OSMRE considers mining to affect the commitment of a resource "irreversibly" when it results in the productivity of that resource (current and/or potential) being lost and, once lost, remaining unregainable (i.e., the loss of this productivity cannot be "reversed"). OSMRE considers mining to affect the commitment of a resource "irretrievably" when it results in the productivity of that resource (current and/or potential) being lost during the life of the mine but becoming regainable at some future time (i.e., the loss of the productivity can be "reversed").

Air quality would be irretrievably degraded and visibility irretrievably reduced during the life of the proposed mine.

The major irreversible commitment of resources at the proposed Dry Fork mine would be the mining and consumption of 226.4 million tons of coal to be used for electrical power generation during the 21 years of mining. OSMRE estimates that 1 to 2 percent of the energy PPC produced would be required to mine the coal. Approximately 3.8 million bank cubic yards of scoria (32 percent of the scoria resource on the proposed permit area) would be irreversibly lost, because it would be mined and used by the mining operation.

Mining and mining-related activites at the proposed mine would irreversibly change the quality of approximately 10,053,000 bank cubic yards of topsoil material. Soil formation processes, although continuing, would be irreversibly

altered by these activities. Newly formed soil material would be unlike that in surrounding unmined areas.

The approximate 22-percent maximum reduction in flow in Moyer Springs Creek, of which 17 percent would be attributable to the proposed Dry Fork mine alone, would irretrievably reduce brook trout productivity in the stream, mainly during the period of mining and reclamation although somewhat even after several hundred years.

Ground water that normally discharges at Moyer Springs would become pit inflow used for dust control at the proposed Dry Fork mine. In consequence, except during those years of the mining operation when some pit inflow would be discharged to Dry Fork Little Powder River, this ground water would be irretrievably lost to downstream water users over the short term. Over the long term, the salinity of Moyer Springs discharge would increase, constituting an irreversible change in water quality. All of the other impacts of the proposed Dry Fork mine on the hydrologic resource would be irretrievable. Potentiometric surfaces lowered by mining would eventually recover during the postmining phase of the project.

The forage that disturbed land could have produced would be irretrievably lost during the period of mining and reclamation.

Mining would irreversibly alter the scoria/break habitat that would be mined and would thereby reduce the overall value of wildlife habitat in the proposed Dry Fork life-of-mine area for certain species associated with scoria/break habitat (e.g., mule deer and ferruginous hawks).

The proposed Dry Fork mine would require a workforce of up to 520 employees during the first 15 years of its operation. After it had operated 20 years, the mine would require steadily fewer workers. The labor expended by the workforce during the life of the mine would be an irretrievable commitment of human resources.

Loss of life and disabling injuries would occur owing both to the mining operations and to increased vehicular and train traffic. These would, respectively, be irreversible and irretrievable commitments of human resources.

Investment by local government entities of revenues generated by the proposed mine to provide public facilities and services to area residents would be an irreversible commitment of local financial resources. The benefits of local investment of revenues would diminish as population and, hence, demand for public services declined.

The lost use of the land and its resources for public recreation during the life of the mine would be an irretrievable commitment of the resource, because these resources would be lost for recreation purposes throughout the life of the mine but retrieved in the future if necessary.

Such materials as steel, aluminum, and copper, used for the railroad and transmission lines and in the manufacturing of mining machinery and buildings would be committed irretrievably as long as they were in use, but many of these materials would be salvagable upon their abandonment.

Any loss of cultural resource information attributable to vandalism, the accidental destruction of undiscovered sites, or the shortcomings of current methodology or technology would be permanent and so irreversible.

C. IMPACTS OF MINING UNDER ALTERNATIVE 2

Under this alternative, OSMRE reanalyzed the probable impacts to the quality of the human environment that would result from surface coal mining operations at the proposed Dry Fork mine and the probable cumulative impacts that would result from surface coal mining operations at the eight mines north and east of Gillette, subject to the additional mitigation measures identified in the "Alternative 2: Approval of the Proposed Mining Plan, with Additional Mitigation Measures Over and Above the Conditions of Approval Imposed Under Alternative 1." (See section A.2 of chapter II.) No change in either the impact analyses or the impact conclusions presented under alternative 1 was evident for many of the impact topics identified during scoping activities. Therefore, only those impact topics that would be affected by the additional mitigation are discussed below. Please refer to section B of this chapter for detailed discussions of the probable impacts under this alternative for those remaining impact topics.

1. Hydrology

a. Impact of mining north and east of Gillette on the quantity of flow from Moyer Springs

OSMRE identified an additional mitigation measure to reduce impacts to the hydrologic resource, whereby PPC would drill a well in the scoria aquifer prior to mining to augment the flow of Moyer Springs Creek during the life of the mine. (See condition No. 10 in section A.2 of chapter II.) The water from this well would be of similar quality (with respect both to its chemical constituents and to its temperature) to the water currently in Moyer Springs Creek, because the source of water that flows from Moyer Springs is the scoria aquifer. The well would be pumped at whatever rate was necessary to augment streamflow to its premining rate. PPC would monitor the creek both prior to and throughout mining to assure that the augmentation well maintained the premining quality and flow rate in the creek.

OSMRE ran its finite difference ground-water model to determine the extent to which an augmentation well drilled in the scoria aquifer would offset the depletion of Moyer Springs Creek. (Note, however, that such a well would itself draw down the scoria aquifer and so may somewhat deplete springflow.) OSMRE assumed such a well would be located at least 4,000 feet away from Moyer Springs, approximately in the NE¼ sec. 30, T. 51 N., R. 71 W. (See appendix D. Note that, before it could implement this mitigation measure, PPC would have to establish a suitable location and design for the well and construct a pipeline from it to Moyer Springs Creek. A well field, rather than a single well, might be needed given the predicted peak pumping rates.) On the basis of this run, OSMRE has shown that, with an augmentation well, flow depletion in Moyer Springs Creek would be about 4 percent. This contrasts with the 22-percent depletion OSMRE has calculated would be attributable to mining at all eight existing and proposed mines north and east of Gillette without the well. (Figure IV-5 shows the flow in Moyer Springs Creek that OSMRE's analysis predicts would occur if an augmentation well were used to supplement the flow of the creek.) If the proposed Dry Fork mine were not

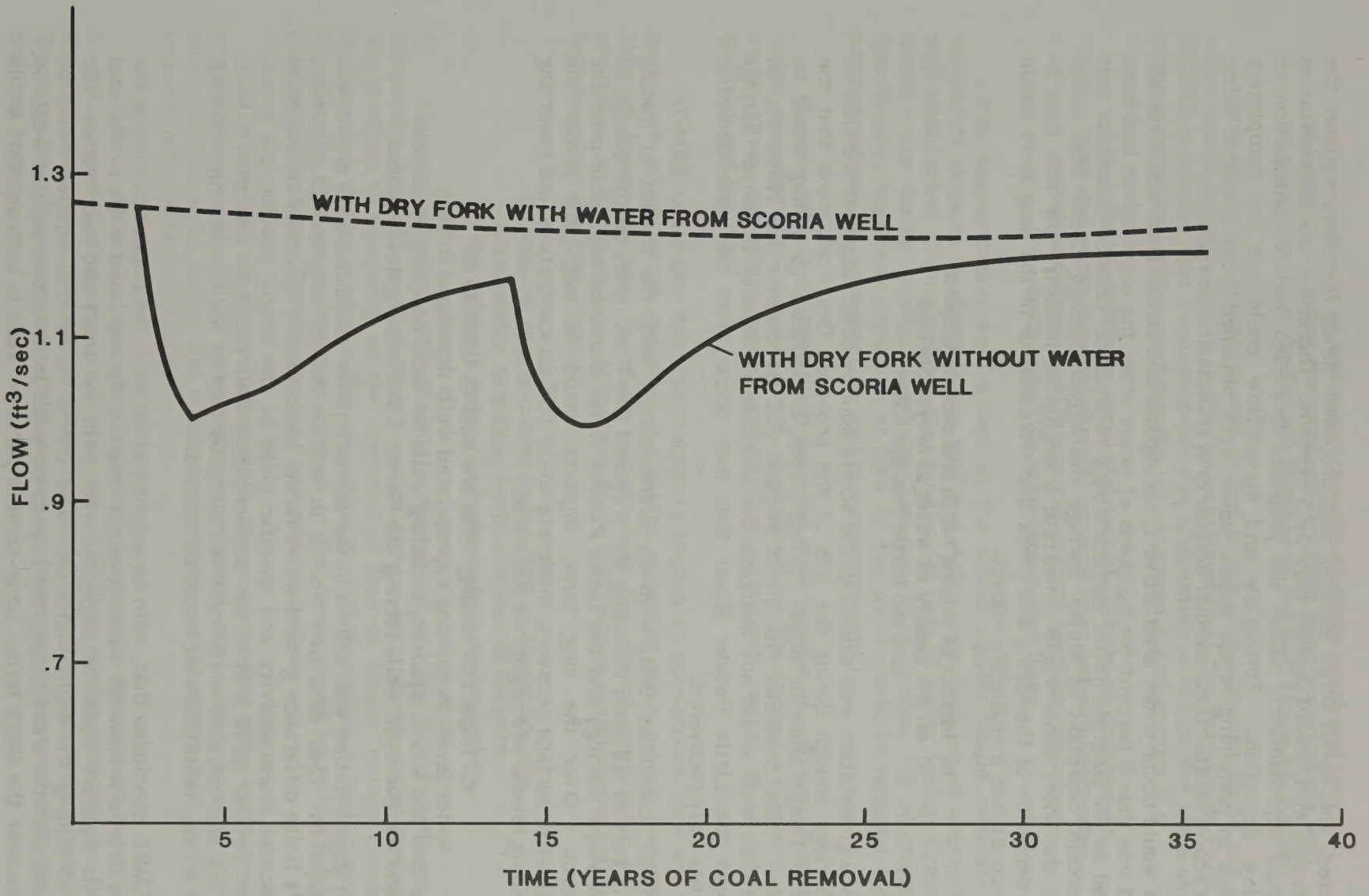

Figure IV-5.--Predicted flows of Moyer Springs Creek, with the eight existing and proposed mines north and east of Gillette, assuming PPC were to augment the flow of the creek with water from a well drilled in the scoria aquifer.

constructed, the seven other existing and proposed mines together, without the augmentation well, would deplete flow by 5 percent. Therefore, the augmentation well should approximately offset the proposed Dry Fork mine's contribution to streamflow depletion. Springflow and streamflow could not be completely augmented to premining levels unless water were obtained from a source other than the scoria aquifer (i.e., another aquifer or a transbasin diversion).

As would occur under alternative 1, springflow and streamflow would remain depleted less than 5 percent for hundreds of years after the eight mines had been reclaimed as the potentiometric surface slowly recovered. OSMRE concludes that the 4-percent depletion of Moyer Springs and Moyer Springs Creek that would occur in the short term would constitute a negligible impact; the less than 5-percent depletion of the spring and creek that would occur in the long term would likewise constitute a negligible impact.

b. Impact of mining north and east of Gillette on the quality of water in Moyer Springs and the Little Powder River

An augmentation well drilled in the scoria aquifer could augment the flow of Moyer Springs enough during the life of the proposed Dry Fork mine that the increase in temperature in Moyer Springs Creek attributable to mining would be negligible. (See condition No. 10 in section A.2 of chapter II.) However, an augmentation well would not mitigate the increase in salinity in Moyer Springs Creek and the Little Powder River that may occur after the potentiometric surface has fully recovered.

OSMRE concludes that, with an augmentation well, the impact of mining north and east of Gillette, including the proposed Dry Fork mine, on the quality of water in Moyer Springs and the Little Powder River would be negligible over the short term. Over the long term, impacts would be negligible while the potentiometric surface recovers, moderate while TDS concentrations are reverting to premining levels, and negligible thereafter.

c. Impact of mining north and east of Gillette on water levels in existing appropriated wells developed in both the coal and scoria aquifers, including wells for local ranching operations and the domestic wells serving the Garner Lake housing development

An augmentation well drilled in the scoria aquifer would increase drawdowns in the aquifer. (See condition No. 10 in section A.2 of chapter II.) However, OSMRE's finite difference ground-water model (described in appendix D) indicates that, because transmissivity and specific yield in the scoria aquifer are great, drawdown beyond 1,000 feet of the augmentation well would be less than 1 foot. No existing appropriated wells occur within 1,000 feet of the site at which OSMRE assumed an augmentation well would be located.

OSMRE concludes that, with an augmentation well, the impact of mining the proposed Dry Fork mine on water levels in existing appropriated wells in the coal and scoria aquifers would be negligible over both the short and long terms. The impact of mining the eight mines on water levels in the coal aquifer would be significant over the short term; the impact on wells in the scoria aquifer would be negligible over the short term. Long-term impacts on wells in both aquifers would be negligible.

d. Impacts of water-supply wells at mines north and east of Gillette, including the proposed Dry Fork mine water-supply well, on water levels in the Tullock Member of the Fort Union Formation

Because an augmentation well drilled in the scoria aquifer would not affect water levels in wells drilled in the Tullock Member of the Fort Union Formation, OSMRE concludes that impacts under this alternative would be the same as those under alternative 1. (See condition No. 10 in section A.2 of chapter II.)

e. Impacts of mining north and east of Gillette on downstream land and water use, including (1) impacts from potential excessive water discharges and (2) impacts to local ranching operations from reduction in surface-water flows

Any augmentation well drilled in the scoria aquifer would mitigate most temporary impacts on downstream land and water uses, because an augmentation well would offset the majority of the depletion of flow of Moyer Springs Creek that would occur during mining. (See condition No. 10 in section A.2 of chapter II.) Specifically, maximum depletion of flow in the creek would be reduced from 22 percent without an augmentation well to 4 percent with it.

If, even with an augmentation well, the water source of a downstream land or water user remained contaminated, diminished, or interrupted by mining at the eight mines, the mines would replace that water with water of an equivalent quantity and quality.

OSMRE concludes that the temporary impact to downstream land and water uses from mining north and east of Gillette, resulting from mining reducing the flow of Moyer Springs, would be mitigated by the mines' compliance with the provisions of Wyoming law. In consequence, this impact would be negligible over both the short and long terms.

f. Impacts of a decrease in the flow of Moyer Springs, attributable to mining north and east of Gillette, on the value of water rights dependent on the springs

Any augmentation well drilled in the scoria aquifer would mitigate most temporary impacts on downstream water rights, because an augmentation well would offset the majority of the depletion of flow of Moyer Springs Creek that would occur during mining. (See condition No. 10 in section A.2 of chapter II.) Specifically, maximum depletion of flow in the creek would be reduced from 22 percent without an augmentation well to 4 percent with it.

If, even with an augmentation well, the water source of a surface- and/or ground-water rights holder remained contaminated, diminished, or interrupted by mining at the eight mines, the mines would replace that water with water of an equivalent quantity and quality.

OSMRE concludes that the temporary impact to downstream water rights from mining north and east of Gillette, resulting from mining reducing the flow of Moyer Springs, would be mitigated by the mines' compliance with the provisions of Wyoming law. In consequence, this impact would be negligible over both the short and long terms.

2. Vegetation

a. Impacts of flow reductions in Moyer Springs Creek, attributable to mining north and east of Gillette, on (1) wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek and (2) wetlands and irrigated agricultural lands adjacent to the Little Powder River

OSMRE identified an additional mitigation measure to reduce impacts to the vegetation resource, whereby PPC would drill a well in the scoria aquifer prior to mining to augment the flow of Moyer Springs Creek during the life of the mine. (See condition No. 10 in section A.2 of chapter II.) An augmentation well would approximately offset the proposed Dry Fork mine's 17-percent contribution to streamflow depletion; an augmentation well would not offset the 4-percent contribution to streamflow depletion attributable to the seven other existing and proposed mines north and east of Gillette.

OSMRE concludes that under this alternative the impacts of flow reductions in Moyer Springs Creek, attributable to mining the proposed Dry Fork mine, on wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek and wetlands and irrigated agricultural lands adjacent to the Little Powder River would be negligible over the short term.

3. Wildlife

a. Impacts on the brook trout population in Moyer Springs Creek of flow reductions in Moyer Springs attributable to the proposed Dry Fork mine

OSMRE identified an additional mitigation measure to reduce impacts to the brook trout population in Moyer Springs Creek, whereby PPC would drill a well in the scoria aquifer to augment the flow of the creek during the life of the mine. (See condition No. 10 in section A.2 of chapter II.) This well would be pumped from the second through the thirty-fourth year of the proposed Dry Fork mining and reclamation operation; it would approximately offset any reduction in flow attributable to the proposed Dry Fork mine alone; it would not offset the approximate 4-percent reduction in flow attributable to the seven other mines north and east of Gillette.

OSMRE concludes that, with an augmentation well, the impacts of flow reduction in Moyer Springs, attributable to the eight mines, including the proposed Dry Fork mine, on the brook trout population in Moyer Springs Creek would be reduced from potentially significant to negligible over the short term. Because the well would not be pumped beyond the life of the mine, impacts would remain minor over the long term.

b. Impacts on the brook trout population of Moyer Springs Creek from increased fishing pressure attributable to mining north and east of Gillette

OSMRE identified an additional mitigation measure to ensure that the brook-trout population in Moyer Springs Creek would not be reduced to too low a level, whereby PPC would implement a no-fishing policy for the creek. (See condition No. 11 in section A.2 of chapter II.) Implementing and enforcing this policy would

substantially reduce or eliminate the adverse impacts of legal and illegal fishing on brook trout in Moyer Springs Creek. The efforts to closely monitor the impacts of springflow reduction on the brook trout population would not be complicated by fishing pressure.

OSMRE concludes that, with PPC's implementation and enforcement of a no fishing policy, the impact primarily of the proposed Dry Fork mine but also of the seven other mines north and east of Gillette on the brook trout population of Moyer Springs Creek would be reduced from significant to negligible over the short term and from significant to nonexistent over the long term.

c. Impacts on raptors of the loss, attributable to mining north and east of Gillette, of nesting sites and of habitat that supports prey species

OSMRE identified an additional mitigation measure to reduce impacts to raptors, whereby PPC would install and maintain artificial nest structures for raptors on reclaimed lands until planted cottonwoods reached sufficient size to support raptor nests. (See condition No. 12 in section A.2 of chapter II.) These artificial nesting platforms would reduce the length of time that nesting sites would be unavailable on the disturbed land within the Dry Fork life-of-mine area. In the other seven life-of-mine areas, the effect of mining on potential raptor nesting sites and on prey and its habitat would be as described under alternative 1.

OSMRE concludes that, with the installation and maintenance of nest platforms, the impacts on raptors of the loss, attributable to the proposed Dry Fork mine, of nesting sites and of habitat that supports prey species would be minor over the short and long terms. However, the overall impacts on raptors in the eight life-of-mine areas of the loss, attributable to the eight mines, of nesting sites and of habitat that supports prey species would be moderate over the short term and minor over the long term.

d. Impacts of the proposed Dry Fork mine on golden eagles protected by the Bald Eagle Protection Act, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.

OSMRE identified an additional mitigation measure to reduce impacts to golden eagles, whereby PPC would annually monitor and repair, if necessary, the golden eagle artificial nest platform until planted cottonwood reached sufficient size to support golden eagle nests. (See condition No. 13 in section A.2 of chapter II.)

OSMRE concludes that, with the maintenance of the eagle nest platform, the impacts of the proposed Dry Fork mine on the pair of golden eagles whose nest USFWS moved from the proposed life-of-mine area would be moderate over both the short and long terms.

D. IMPACTS UNDER ALTERNATIVE 3

1. Air Quality

a. Impacts to air quality from increased particulate levels attributable to mining north and east of Gillette

The seven mines, excluding the proposed Dry Fork mine, operating at maximum production under highest projected emissions would degrade air quality both within the seven life-of-mine areas and in the vicinity of Gillette. However, OSMRE predicts that mining activities at the seven mines would not generate TSP concentrations that exceed the State annual geometric-mean standard of 60 $\mu g/m^3$ or the Federal PM_{10} standard of 150 $\mu g/m^3$ (arithmetic mean) on or in the vicinity of the seven life-of-mine areas. Under high-wind-speed conditions, emissions from the seven mines could exceed both the 24-hour Wyoming TSP standard of 150 $\mu g/m^3$ (geometric mean) and the Federal PM_{10} standard of 150 $\mu g/m^3$ (arithmetic mean) within and in the vicinity of the seven life-of-mine areas. Likewise, emissions from the seven mines could exceed both the 24-hour Wyoming TSP standard and the Federal PM_{10} standard in Gillette when high winds blow particulates from the seven-mine area toward Gillette.

OSMRE concludes that the seven surface coal mines operating simultaneously at maximum production under highest projected emissions conditions would cause a moderate, short-term increase in both TSP and PM_{10} concentrations within the proposed Dry Fork life-of-mine area and a moderate, short-term increase outside the life-of-mine area. Increases in TSP and PM_{10} concentrations both within and outside the seven life-of-mine areas would be minor over the long term.

2. Geology

a. Impacts of the proposed Dry Fork mine on the scoria resource within the life-of-mine area

Because the Dry Fork property would not be mined, no impacts to the scoria resource within the proposed life-of-mine area attributable to a mine on the property would occur. Without the proposed mine, the scoria resource could be mined immediately and without interruption. However, to date, no interest (other than the prospective interest of the proposed mine) has been shown for developing this resource.

b. Impacts of the proposed Dry Fork mine on oil production within the life-of-mine area

Because the Dry Fork property would not be mined, no impacts to oil production within the life-of-mine area attributable to a mine on the property would occur. Without the proposed mine, oil production from the three wells within the proposed disturbance area could continue uninterrupted.

3. Topography

a. Impacts of lowering and flattening the life-of-mine areas north and east of Gillette

Mining activities at the seven mines would remove about 81 vertical feet of coal from coal seams underlying the seven life-of-mine areas. Given that the average thickness of overburden in the life-of-mine areas is about 149 feet, and the spoil swell factor in the areas is about 17 percent, mining activities at the seven mines would lower the elevation of disturbed acreage within the seven life-of-mine areas (approximately 18,839 acres of land) by approximately 50 feet. These activities would also flatten the disturbed acreage.

OSMRE concludes that the impact of the seven mines on the topography of the seven life-of-mine areas would be permanent but minor on a regional basis.

b. Impacts of long, postmining slopes on erosional stability at the proposed Dry Fork mine

Because the Dry Fork property would not be mined, no impacts to erosional stability within the life-of-mine area attributable to a mine on the property would occur.

4. Soils and Overburden

a. Impacts to soil productivity within the proposed life-of-mine areas from topsoiling operations at mines north and east of Gillette

If the proposed Dry Fork mine were not constructed, mining activities at the seven other existing and proposed mines north and east of Gillette would adversely affect the soil forming processes of the approximate 40,419 acre-feet of natural topsoil that would be salvaged in the 18,839-acre area they disturbed in the seven life-of-mine areas. In general, the impact of these seven mines on soils and their productivity would be the same as those described under alternative 1.

OSMRE concludes that the impact of the seven mines on soil productivity within the seven life-of-mine areas would be negligible over the long term.

b. Impacts on revegetation success and ground-water quality of unsuitable overburden at mines north and east of Gillette

As described under alternative 1, the permittees of seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, have developed programs to specially handle unsuitable overburden and to monitor and sample regraded spoil. Should these sampling programs identify unsuitable overburden, each further proposes measures that, when implemented, would assure that unsuitable overburden would not interfere with revegetation or degrade the ground water.

OSMRE concludes that the impact of unsuitable overburden at the seven mines on revegetation success and ground-water quality would be negligible over the long term.

5. Hydrology

a. Impact of mining north and east of Gillette on the quantity of flow from Moyer Springs

If the proposed Dry Fork mine were not constructed, the seven other existing and proposed mines together would deplete the flow of Moyer Springs Creek by about 5 percent. (See discussion under alternative 1.) The long-term depletion would be less than 5 percent.

OSMRE concludes that mining the seven mines, excluding the proposed Dry Fork mine, would result in a negligible impact to Moyer Springs Creek over both the short and long terms.

b. Impact of mining north and east of Gillette on the quality of water in Moyer Springs and the Little Powder River

The seven mines, excluding the proposed Dry Fork mine, would somewhat increase the salinity of Moyer Springs's discharge over the long term. The magnitude of the impact to water quality in Moyer Springs and the Little Powder River is difficult to estimate, but it would be slightly smaller than the impact that would occur if all eight mines were mined.

OSMRE concludes that the impact of mining the seven mines on the salinity of Moyer Springs and Little Powder River water would be negligible over the short term. Over the long term, impacts would be negligible while the potentiometric surface recovers, moderate while TDS cencentrations are reverting to premining levels, and negligible thereafter.

c. Impact of mining north and east of Gillette on water levels in existing appropriated wells developed in boththe coal and scoria aquifers, including wells for local ranching operations and the domestic wells serving the Garner Lake housing development

The seven mines, excluding the proposed Dry Fork mine, would draw down the coal aquifer extensively, particularly to the south and west of the proposed mine. Figure V-8 in appendix D shows the drawdowns OSMRE calculates would have occurred at the end of mining the eight mines, by which time drawdowns would be extensive (greater than 5 feet throughout the extent of the eight life-of-mine areas except in the scoria aquifer and the Dry Fork life-of-mine area).

The seven mines would affect wells completed in the coal aquifer to a significant extent over the short term. Most wells in the coal aquifer are mining company coal-monitoring wells. However, PPC lists 27 coal-aquifer wells within 3 miles of its proposed Dry Fork life-of-mine-area boundary that appropriate ground water for use (i.e., nonmonitoring wells; Phillips Petroleum Company, 1982-86). The water levels in all of these wells would be significantly lowered: some may be destroyed by mining; others may go dry owing to the large predicted fall in the coal aquifer potentiometric surface. However, this impact would be negligible over the long term, because water levels would eventually recover to their premining conditions.

Wells in the scoria aquifer, including the Garner Lake subdivision wells, would not be significantly affected by mining the seven mines. Drawdowns in the scoria

aquifer would be small because of the aquifer's great hydraulic conductivity and specific yield.

OSMRE concludes that the impact of mining the seven mines on water levels in wells in the coal aquifer would be significant over the short term. The impact of mining on water levels in wells in the scoria aquifer would be negligible over the short term. Long-term impacts on wells in both aquifers would be negligible.

d. Impacts of water-supply wells at mines north and east of Gillette on water levels in the Tullock Member of the Fort Union Formation

Together, the seven mines' water-supply wells and other wells completed in the Tullock aquifer would substantially draw down the Tullock Member of the Fort Union Formation. Under this alternative, PPC would not construct a water-supply well for its proposed Dry Fork mine. However, because a water-supply well completed in the Tullock aquifer underlying the Dry Fork property would not by itself substantially draw down that aquifer, not constructing the well would have little effect on overall drawdown in the aquifer. Therefore, drawdowns under this alternative, attributable to all other wells completed in the aquifer, would be only slightly smaller than the cumulative drawdowns predicted under alternative 1.

OSMRE concludes that the cumulative impact of the Fort Union Formation water-supply wells, including the seven mines' water-supply wells, would be to increase the pumping costs for all of them. This would be a moderate impact to well users over the short term and a minor impact over the long term.

e. Impacts of mining north and east of Gillette on downstream land and water use, including (1) impacts from potential excessive water discharges and (2) impacts to local ranching operations from reduction in surface-water flows

OSMRE concludes the impact of the seven mines on downstream land and water uses would be negligible over both the short and long terms, both because the depletion of Moyer Springs would be negligible and because Wyoming law requires the replacement of water rights adversely affected by surface coal mining activities.

f. Impacts of a decrease in the flow of Moyers Springs, attributable to mining north and east of Gillette, on the value of water rights dependent on the springs

OSMRE concludes the impact of the seven mines on downstream surface-water rights would be negligible over both the short and long terms, both because the depletion of Moyer Springs would be negligible and because Wyoming law requires the replacement of water rights adversely affected by surface coal mining activities.

6. Vegetation

a. Impacts of flow reductions in Moyer Springs, attributable to mining north and east of Gillette, on (1) wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek and (2) wetlands and irrigated agricultural lands adjacent to the Little Powder River

If the proposed Dry Fork mine were not constructed, the seven other existing and proposed mines together would deplete the flow of Moyer Springs Creek by about 5 percent. The long-term depletion would be less than 5 percent. OSMRE concludes that the impacts to the wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek as well as to wetlands and irrigated agricultural lands adjacent to the Little Powder River would be negligible over both the short term and the long term.

b. Impacts of the proposed Dry Fork mine on bottomland vegetation within the proposed life-of-mine area

Because the Dry Fork property would not be mined, no impacts to bottomland vegetation attributable to a mine on the property would occur.

7. Wildlife

a. Impacts on the brook trout population in Moyer Springs Creek of flow reductions in Moyer Springs attributable to mining north and east of Gillette

Because the Dry Fork property would not be mined, no impacts to the brook-trout population in Moyer Springs Creek attributable to a mine on the property would occur. However, lacking PPC's involvement, the opportunity to enhance riparian habitat along Moyer Springs Creek would be lost unless Citco, the owner of the land along the creek, possibly with the assistance of Wyoming GFD, voluntarily planted shrubs along the creek.

Seven of the eight existing and proposed mines north and east of Gillette, excluding the proposed Dry Fork mine, would deplete the flow of Moyer Springs Creek somewhat (by about 5 percent).

OSMRE concludes that the impact of flow reductions in Moyer Springs, attributable to mining the seven mines, on the brook trout population in Moyer Springs Creek would be minor over both the short and long terms.

b. Impacts on the brook trout population in Moyer Springs Creek of increased fishing pressure attributable to mining north and east of Gillette

Seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would increase fishing pressure in the creek, but probably only slightly.

OSMRE concludes that the impact of increased fishing pressure attributable to mining the seven mines would be negligible over the short term and nonexistent over the long term.

c. Impacts to raptors of the loss, attributable to mining north and east of Gillette, of nesting sites and of habitat that supports prey species

Mining and related activities at seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would affect a total of 26,625 acres of existing and potential raptor habitat in the seven life-of-mine areas. Because the Dry Fork property would not be mined under this alternative, at least 1 of the 13 pairs of raptors currently nesting in the eight life-of-mine areas (a red-tailed hawk pair nesting in sec. 25) would not be disturbed.

OSMRE concludes that the impacts on raptors of the loss, attributable to the seven mines, of nesting sites and of habitat that supports prey species would be moderate over the short term and minor over the long term.

d. Impacts of the proposed Dry Fork mine on golden eagles protected by the Bald Eagle Protection Act, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.

Because the Dry Fork property would not be mined, habitat on the property that supports prey species would not be disturbed. However, the nest platform USFWS constructed, given the prospect of a mine on the property, for the golden-eagle pair nesting in sec. 25 would eventually deteriorate and become unsuitable for eagle nesting. In order to assure that the pair was not adversely affect as a consequence, USFWS would have to maintain the platform or relocate the nest into a suitable cottonwood tree.

Because the golden eagles formerly on the Dry Fork property have already been moved and could be relocated again, the original decision to lease the property has already affected and would continue to somewhat affect them. OSMRE concludes that the impact on these eagles has been and should remain negligible over the short term but could become moderate over the long term if proper nest maintenance does not occur.

e. Impacts of mining north and east of Gillette on migratory birds of high Federal interest, including ferruginous hawks, burrowing owls, and mountain plovers

Because no migratory birds of high Federal interest have been located on or adjacent to the proposed Dry Fork life-of-mine area, the impacts to migratory birds of high Federal interest attributable to mining seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would be as described under alternative 1.

OSMRE concludes that the impact of the seven mines on migratory birds of high Federal interest has the potential to become significant over both the short and long terms.

f. Impacts of the proposed Dry Fork mine on the pair of red-tailed hawks nesting in sec. 25, T. 51 N., R. 72 W.

Because the Dry Fork property would not be mined, no impacts to the pair of red-tailed hawks nesting in the proposed life-of-mine area attributable to a mine on the property would occur.

g. Impacts of mining north and east of Gillette on pronghorn of the Gillette and North Black Hills Herd units

Mining and related activities at seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would disturb approximately 0.9 percent of the occupied pronghorn habitat (or 18,839 acres) within the Gillette and North Black Hills Herd units delineated by Wyoming GFD (which have a total acreage of 2,118,400 acres). Wyoming GFD has classified all the occupied pronghorn habitat that the seven mines would disturb as yearlong habitat; Wyoming GFD has classified a partof the habitat as winter range. The impacts of the seven mines on this habitat would be as described under alternative 1.

OSMRE concludes that the impacts of the seven mines on pronghorn of the Gillette and North Black Hills Herd units would be moderate over both the short and long terms.

h. Impacts of mining north and east of Gillette on mule deer of the Powder River Herd unit

Mining seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would disturb only a small part of the occupied mule deer habitat within the Powder River Herd unit. The effects of this disturbance would be as described under alternative 1.

OSMRE concludes that the impacts of the seven mines on mule deer of the Powder River Herd unit would be minor over both the short and long terms.

i. Impacts of mining north and east of Gillette on sage grouse of Management Area 43

Mining and related activities at seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would disturb a part of the habitat used by sage grouse within Management Area 43 for brood rearing, wintering, and normal maintenance. The effects of this disturbance would be as described under alternative 1.

OSMRE concludes that the impacts of the seven mines on the sage grouse of Management Area 43 would be moderate over both the short and long terms.

j. Secondary impacts on wildlife of the loss of habitat related to population growth and the increased incidence of road kills, general harassment, and poaching, all attributable to mining north and east of Gillette

Beyond their direct effects, mining and related activities at seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would generate indirect effects on wildlife, perpetrated in any of several ways by the people affiliated with these activities. With the seven mines, the population of Campbell County is projected to peak in the year 1994; from 1985 to 1994, the county's population would increase by 9,644 persons or by 26 percent (Richardson Associates, 1985). Specifically, the indirect effects of this population on wildlife would be as described under alternative 1.

OSMRE concludes that the secondary impacts on wildlife of the loss of habitat related to population growth and the increased incidence of road kills, general harassment, and poaching, all attributable to the seven mines, has the potential to become significant over the short term but would be moderate over the long term.

8. Socioeconomics

a. Impacts of mining on employment, personal income, and population in Gillette and Campbell County

Employment, personal income, and population, excluding those amounts attributable to the proposed Dry Fork mine, would be anticipated to follow the same general pattern of increase and decrease over the next 20 to 30 years that was discussed under alternative 1.

Without the proposed Dry Fork mine, peak mining employment could rise 54.9 percent and total county employment could rise 29.1 percent above similar employment in 1984 (Richardson Associates, 1985; table III-6). Total personal income could rise 46.7 percent over the estimated total personal income in 1984 (Richardson Associates, 1985). Peak populations in both Campbell County and the city of Gillette could still occur as early as 1994 and 2005 (approximate), respectively, and could rise as much as 26.3 percent in the county and 44.6 percent in the city over those estimated for 1984 (Richardson Associates, 1985; table III-8). The populations of Gillette and Campbell County would decline after mining activity ceases, with or without the proposed Dry Fork mine, to their 1980 levels.

OSMRE concludes that the impact on employment, personal income, and population in Gillette and Campbell County from mining, excluding the proposed Dry Fork mine, would be moderate through 2005 (approximate), when the peak effect is anticipated to occur (i.e., short term). After 2005, employment at mines in Campbell County would decline, causing an overall decline in employment (and, in consequence, personal income and population) in Gillette and the county. Therefore, OSMRE further concludes that the impact on employment, personal income, and population in Gillette and Campbell County from mining has the potential to become significant beyond the year 2005 (approximate) because of the loss of income and economic opportunity (i.e., short term and long term).

b. Impacts of mining on housing in Gillette and Campbell County, including impacts to property values in the Garner Lake housing development

Mining seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, would influence the need for housing in Gillette and the value of property in the Garner Lake housing development to the extent and in the manner described under alternative 1.

OSMRE concludes that the impact of the seven mines on housing requirements in Gillette and Campbell County would be minor over both the short term and the long term. OSMRE also concludes that the impacts of these mines on property values in the Garner Lake housing development would be minor over both the short term and the long term.

c. Impacts of mining on the public sector fiscal conditions of Gillette, Campbell County, and the Campbell County School District

In general, requirements for extensive capital improvement expenditures would decrease over the coming years throughout Gillette, Campbell County, and the Campbell County School District. The effects of these decreased requirements would be as described under alternative 1.

OSMRE concludes that the impact of mining seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, on the public sector fiscal conditions of Gillette, Campbell County, and the Campbell County School District would be minor over both the short and long terms.

d. Impacts of mining on social well-being in Gillette and Campbell County

OSMRE projects that population, employment opportunities, and public fiscal conditions will remain relatively stable in Gillette and Campbell County past the year 2000; thereafter, population and employment in the city and county would begin to decline. The effects of this stability followed by decline would be as described under alternative 1.

OSMRE concludes that the impact of mining seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, on social well-being in Gillette and Campbell County would be minor and positive until area mines begin to close (i.e., short term). After they begin to close (i.e., long term), the impact of mining on social well-being would be minor and negative.

9. Recreation

a. Impacts of mining on public recreation facilities and services in Gillette, Campbell County, and Keyhole State Park

Additional demand for recreation factilities in Gillette, Campbell County, and Keyhole State Park would be generated by increases in population. The effects of this increase would be as described under alternative 1.

OSMRE concludes that the impact of the seven mines on public recreation facilities and services in Gillette and Campbell County would be minor over both the short term and the long term. Unless funds are secured to improve Keyhole State Park, the park could continue to be overused and unable to meet recreational demand. Persons affiliated in some respect with the seven mines could compound this overuse; therefore, the impact of the mines on the park has the potential to become significant over the short term but would be minor over the long term.

10. Transportation

a. Impacts of increased traffic, attributable to mining north and east of Gillette, on public safety and on traffic flow in and around Gillette

The primary transportation routes that would be affected by developing seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, are Garner Lake Road, U.S. 14-16, Wyoming 59, and the internal circulation routes through Gillette. Traffic associated with the proposed East Gillette

Federal, Fort Union, and Clovis Point mines would substantially increase the traffic over Garner Lake Road, thereby increasing the chances of automobile and truck accidents occurring on this road. Traffic associated with the Buckskin, Rawhide, and Eagle Butte mines would somewhat increase traffic over U.S. 14-16 and Wyoming 59.

Many improvements have been made to the internal circulation route through Gillette. These improvements were designed to minimize traffic congestion in downtown Gillette and at the U.S. 14-16/Wyoming 59 intersection.

OSMRE concludes that the impact of increased traffic, attributable to the seven mines, on public safety along Garner Lake Road, U.S. 14-16, and Wyoming 59 has the potential to become significant over the short term and but would be minor over the long term. The impact of increased traffic on traffic flow over the internal circulation routes through Gillette would be minor over both the short term and the long term.

b. Impacts of increased coal train traffic, attributable to mining north and east of Gillette, on public safety and automobile-traffic flow at at-grade railroad highway crossings

The Buckskin, Rawhide, Eagle Butte, Fort Union, Clovis Point, and proposed East Gillette Federal mines transport or would transport their coal along a Burlington-Northern railroad spur to the Burlington-Northern main line. The Wyodak mine uses the Burlington-Northern main line itself to transport coal. At full production, the six mines using the spur would have increased train traffic along it from the 1984 level of 30 to as many as 80 round trips per week.

OSMRE concludes that the impact of seven of the eight mines north and east of Gillette on public safety and automobile traffic flows at at-grade railroad highway crossings would be moderate over the short term and minor over the long term.

11. Cultural Resources

a. Direct and indirect impacts of mining north and east of Gillette on historic and prehistoric sites on and adjacent to the life-of-mine areas

Of the 195 cultural resource sites thus far recorded in seven of the eight life-of-mine areas north and east of Gillette, excluding the proposed Dry Fork mine, and in the buffer zone surrounding them, 21 prehistoric sites and 4 historic sites are eligible for listing in the National Register of Historic Places. Mining the seven mines would destroy a majority of the eligible prehistoric sites and three of the eligible historic sites. The operators of the seven mines would either avoid sites that would be impacted by mining activities and that the Wyoming SHPO found to be sufficiently important or the operators of the mines would implement mitigation measures that would considerably lessen the impacts to these cultural resources.

OSMRE concludes that the majority of cultural resources on or adjacent to the seven life-of-mine areas that would or could be directly or indirectly disturbed by the seven mines are irreplaceable resources and their loss would be permanent. However, given the size of the area, the number and type of historic and

prehistoric sites that mining could disturb, and the fact that mitigation measures have been or would be employed, OSMRE concludes that the impact of the seven mines on cultural resources would be minor.

b. Impacts of mining north and east of Gillette on undiscovered cultural resource sites, especially buried prehistoric sites in the vicinity of Moyer Springs and Moyer Springs Creek

Mining and related activities at seven of the eight mines north and east of Gillette, excluding the proposed Dry Fork mine, could destroy undiscovered cultural resource sites. To reduce this possibility, OSMRE has conditioned the permits it has issued to the owners of these mines so as to require them to report any unanticipated cultural resource find to Wyoming DEQ and OSMRE for evaluation. (Thus far in the course of mining, four cultural resource sites that had not been discovered prior to the commencement of mining have been reported.) The probability of important undiscovered buried prehistoric sites existing on or adjacent to the seven life-of-mine areas is greatest at the Rawhide and Eagle Butte mines.

OSMRE concludes that the impact of the seven mines on undiscovered cultural resource sites has the potential to become significant. Any impact to cultural resource sites, whether from mining or from other causes, is permanent.

12. Visual Resources

a. Impacts to visibility in the Gillette, Wyoming, area and at Devils Tower National Monument from increased particulate and diesel emission levels attributable to mining north and east of Gillette

The seven mines would degrade visibility in the Gillette area and at Devils Tower National Monument. Visibility in the vicinity of Gillette would be reduced by approximately 13 percent or 15 miles (17 miles cumulative visual range reduction attributable to the eight mines; 2 miles visual range reduction attributable to the proposed Dry Fork mine = 15 miles). Under extremely poor meteorological conditions, mining activities at the seven mines would reduce the visual range at the monument by about 1 mile. Assuming that the background visual range at the monument is about the same as that in the Gillette area (approximately 112 miles), the seven mines would reduce the visual range at the monument by less than 1 percent (1 mile divided by 112 miles = 0.9 percent).

OSMRE concludes that the impact of the seven mines to local and regional visibility would be minor and negligible, respectively, over the short term. The impact of the mines to both local and regional visibility would be negligible over the long term.

E. COMPARISON OF ALTERNATIVES

Tables IV-4 and IV-5 show OSMRE's conclusions regarding the intensity and duration of the site-specific and cumulative impacts that would result from mining the proposed Dry Fork mine.

Table IV-4.--Comparison by alternative of the intensity and duration of site-specific impacts that would result from mining the proposed Dry Fork surface coal mine

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Air quality			
Impacts to air quality from increased particulate levels.	Moderate, short term within life-of-mine area; minor, short term outside life-of-mine area. Negligible, longterm.	Same as alternative 1.	No impact.
Geology			
Impacts on the scoria resource within the life-of-mine area.	Minor, permanent.	Same as alternative 1.	No impact.
Impacts to oil production within the life-of-mine area.	Negligible, short term.	Same as alternative 1.	No impact.
Topography			
Impact of lowering and flattening the life-of-mine area.	Minor, permanent.	Same as alternative 1.	No impact.
Impact of long, postmining slopes on erosional stability.	Minor, long term.	Same as alternative 1.	No impact.
Soils and overburden			
Impacts to soil productivity from topsoiling operations.	Negligible, long term.	Same as alternative 1.	No impact.
Impacts on revegetation success and groundwater quality from unsuitable overburden.	Negligible, long term.	Same as alternative 1.	No impact.
Hydrology			
Impact on the quantity of flow from Moyer Springs.	Significant, short term; negligible, long term.	Negligible, short and long term.[1]	No impact.

Table IV-4.--Comparison by alternative of the intensity and duration of site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Hydrology--Continued			
Impact on the quality of water in Moyer Springs and the Little Powder River.	Negligible, short term; moderate, long term.	Negligible, short term; moderate, long term.[1]	No impact.
Impact on water levels in existing appropriated wells developed in both the coal and scoria aquifers, including wells for local ranching operations and the domestic wells serving the Garner Lake housing development.	Negligible, short and long term.	Negligible, short and long term.[1]	No impact.
Impacts of the proposed Dry Fork mine's water-supply well on water levels in the Tullock Member of the Fort Union Formation.	Moderate, short term; negligible, long term.	Same as alternative 1.	No impact.
Impacts on downstream land and water use, including (1) impacts from potential excessive water discharges and (2) impacts to local ranching operations from reduction in surface-water flows.	(1) and (2) Negligible, short and long term.	(1) and (2) Same as alternative 1.	(1) and (2) No impact.
Impacts of a decrease in the flow of Moyer Springs on the value of water rights dependent on the springs.	Negligible, short and long term.	Negligible, short and long term.[1]	No impact.

Table IV-4.--Comparison by alternative of the intensity and duration of site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Vegetation			
Impact of flow reductions in Moyer Springs Creek on (1) wetland vegetation adjacent to Moyer Springs and Moyer Springs Creek and (2) wetlands and irrigated agricultural lands adjacent to the Little Powder River.	(1) Minor, short term; negligible, long term.	(1) Negligible, short and long term.[1]	(1) No impact.
	(2) Negligible, short and long term.	(2) Negligible, short and long term.[1]	(2) No impact.
Impacts on bottomland vegetation within the proposed life-of-mine area.	Minor, short term; negligible, long term.	Same as alternative 1.	No impact.
Wildlife			
Impacts on the brook-trout population in Moyer Springs Creek from flow reductions in Moyer Springs.	Potential to become significant, short term; minor, long term.	Negligible, short term; minor, long term.[1]	No impact.
Impacts on the brook-trout population in Moyer Springs Creek from increased fishing pressure.	Significant, short and long term.	Negligible, short term; no impact, long term.	No impact.
Impacts on raptors from loss of nesting sites and of habitat that supports prey species.	Moderate, short term; minor, long term.	Minor, short and long term.[1]	No impact.
Impacts on golden eagles, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.	Potential to become significant, short term; moderate, long term.	Moderate, short and long term.[1]	No impact.

Table IV-4.--Comparison by alternative of the intensity and duration of site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Wildlife--Continued			
Impacts on migratory birds of high Federal interest, including (1) ferruginous hawks, (2) burrowing owls and (3) mountain plovers.	(1) and (2) Moderate, short term; minor, long term. (3) Minor, short term; negligible, long term.	(1), (2), and (3) Same as alternative 1.	(1), (2), and (3) No impact.
Impacts on the red-tailed hawk pair nesting in sec. 25., T. 51 N., R. 72 W.	Moderate, short term; minor, long term.	Same as alternative 1.	No impact.
Impacts on pronghorn of the Gillette and Black Hills herd units.	Moderate, short and long term.	Same as alternative 1.	No impact.
Impacts on mule deer of the Powder River herd unit.	Minor, short and long term.	Same as alternative 1.	No impact.
Impacts on sage grouse of Management Area 43.	Moderate, short and long term.	Same as alternative 1.	No impact.
Secondary impacts on wildlife from loss of habitat related to population growth and increased incidence of road kills, general harassment, and poaching.	Minor, short and long term.	Same as alternative 1.	No impact.
Socioeconomics			
Impacts on employment, personal income, and population in Gillette and Campbell County.	Moderate through year 17 (short term); potential to become significant beyond year 17 (short and long term).	Same as alternative 1.	No impact.

Table IV-4.--Comparison by alternative of the intensity and duration of site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Socioeeconomics--Continued			
Impacts on housing in Gillette and Campbell County, including impacts to property values in the Garner Lake housing development.	Minor, short and long term.	Same as alternative 1.	No impact.
Impacts on the public-sector fiscal conditions of Gillette, Campbell County, and the Campbell County School District.	Minor, short and long term.	Same as alternative 1.	No impact.
Impacts on social well-being in Gillette and Campbell County.	Minor and positive, short term; minor and negative, long term.	Same as alternative 1.	No impact.
Recreation			
Impacts on public-recreation facilities and services in (1) Gillette, (2) Campbell County, and (3) Keyhole State Park.	(1) and (2) Minor, short and long term. (3) Potential to become significant, short term; minor, long term.	(1), (2), and (3) Same as alternative 1.	(1), (2), and (3) No impact.
Transportation			
Impacts of increased traffic on public safety and traffic flow (1) in and (2) around Gillette.	(1) Minor, short and long term. (2) Potential to become significant, short term; minor, long term.	(1) Same as alternative 1. (2) Same as alternative 1.	(1) No impact. (2) No impact.

Table IV-4.--Comparison by alternative of the intensity and duration of site-specific impacts that would result from mining the proposed Dry Fork surface coal mine--Continued

Impact topic by environmental resource	Intensity and duration of site-specific impact		
	Alternative 1	Alternative 2	Alternative 3
Transportation--Continued			
Impacts of increased coal-train traffic on public safety and automobile-traffic flow at at-grade railroad highway crossings.	Moderate, short term; minor, long term.	Same as alternative 1.	No impact.
Cultural resources			
Direct and indirect impacts to historic and prehistoric sites on and adjacent to the life-of-mine area.	Minor, permanent.	Same as alternative 1.	No impact.
Impacts to undiscovered cultural-resource sites, especially buried prehistoric sites in the vicinity of Moyer Springs and Moyer Springs Creek.	Potential to become significant, permanent.	Same as alternative 1.	No impact.
Visual resources			
Impacts to visibility (1) in the Gillette, Wyoming, area and (2) at Devils Tower National Monument from increased particulate and diesel-emission levels.	(1) Minor, short term; negligible, long term. (2) Negligible, short and long term.	(1) Same as alternative 1. (2) Same as alternative 1.	(1) No impact. (2) No impact.

[1]The intensity of the impact identified under this alternative is less than the intensity identified for alternative 1; however, the reduction is not great enough to move it into the next lower level of intensity.

Table IV-5.--Comparison by alternative of the intensity and duration of cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming

(Note that, under alternatives 1 and 2, all eight existing and proposed mines north and east of Gillette, including the proposed Dry Fork mine, would be mined. Under alternative 3, seven of these existing and proposed mines, excluding the proposed Dry Fork mine, would be mined)

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Air quality			
Impacts to air quality from increased particulate levels.	Moderate, short term; minor, long term.	Same as alternative 1.	Moderate, short term; minor, long term.[1]
Topography			
Impact of lowering and flattening the life-of-mine areas.	Minor, permanent.	Same as alternative 1.	Minor, permanent.[1]
Soils and overburden			
Impacts to soil productivity from topsoiling operations.	Negligible, long term.	Same as alternative 1.	Negligible, long term.[1]
Impacts on revegetation success and groundwater quality from unsuitable overburden.	Negligible; long term.	Same as alternative 1.	Negligible, long term.[1]
Hydrology			
Impact on the quantity of flow from Moyer Springs.	Significant, short term; negligible, long term.	Negligible, short and long term.[1]	Negligible, short and long term.[1]
Impact on the quality of water in Moyer Springs and the Little Powder River.	Negligible, short term; moderate, long term.	Negligible, short term; moderate, long term.[1]	Negligible, short term; moderate, long term.[1]

Table IV-5.--Comparison by alternative of the intensity and duration of cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Hydrology--Continued			
Impact on water levels in existing appropriated wells developed in both the (1) coal and (2) scoria aquifers, including wells for local ranching operations and the domestic wells serving the Garner Lake housing development.	(1) Significant, short term; negligible, long term. (2) Negligible, short and long term.	(1) Significant, short term; negligible, long term.[1] (2) Negligible, short and long term.[1]	(1) Significant, short term; negligible, long term.[1] (2) Negligible, short and long term.[1]
Impacts of the eight mines' water-supply wells on water levels in the Tullock Member of the Fort Union Formation.	Moderate, short term; minor, long term.	Same as alternative 1.	Moderate, short term; minor, long term.[1]
Impact on downstream land and water use, including (1) impacts from potential excessive water discharges and (2) impacts to local ranching operations from reductions in surface-water flows.	(1) and (2) Negligible, short and long term.	(1) and (2) Same as alternative 1.	(1) and (2) Negligible, short and long term.[1]
Impacts of a decrease in the flow of Moyer Springs on the value of water rights dependent on the springs.	Negligible, short and long term.	Negligible, short and long term.[1]	Negligible, short and long term.[1]

Table IV-5.--Comparison by alternative of the intensity and duration of cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Vegetation			
Impact of flow reductions in Moyer Springs Creek on (1) wetland vegetation adjacent to Moyer Springs Creek and (2) wetlands and irrigated agricultural lands adjacent to the Little Powder River.	(1) Minor, short term; negligible, long term. (2) Negligible, short and long term.	(1) Negligible, short and long term.[1] (2) Negligible, short and long term.[1]	(1) Negligible, short and long term.[1] (2) Negligible, short and long term.[1]
Wildlife			
Impacts on the brook-trout population in Moyer Springs Creek from flow reductions in Moyer Springs.	Potential to become significant, short term; minor, long term.	Negligible, short term; minor, long term.[1]	Minor, short and long term.[1]
Impacts on the brook-trout population in Moyer Springs Creek from increased fishing pressure.	Significant, short and long term.	Negligible, short term; no impact, long term.	Negligible, short term; no impact, long term.
Impacts on raptors from loss of nesting sites and of habitat that supports prey species.	Moderate, short term; minor, long term.	Moderate, short term; minor, long term.[1]	Moderate, short term; minor, long term.[1]
Impacts on golden eagles, especially the pair formerly nesting in sec. 25, T. 51 N., R. 71 W.	Potential to become significant, short term; moderate, long term.	Moderate, short and long term.[1]	Negligible, short term; moderate, long term.[1]
Impacts on migratory birds of high Federal interest, including ferruginous hawks, burrowing owls, and mountain plovers.	Potential to become significant, short and long term.	Same as alternative 1.	Potential to become significant, short and long term.[1]
Impacts on pronghorn of the Gillette and Black Hills herd units.	Moderate, short and long term.	Same as alternative 1.	Moderate, short and long term.[1]

Table IV-5.--Comparison by alternative of the intensity and duration of cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Wildlife--Continued			
Impacts on mule deer of the Powder River herd unit.	Minor, short and long term.	Same as alternative 1.	Minor, short and long term.[1]
Impacts on sage grouse of Management Area 43.	Moderate, short and long term.	Same as alternative 1.	Moderate, short and long term.[1]
Secondary impacts on wildlife from loss of habitat related to population growth and increased incidence of road kills, general harassment, and poaching.	Potential to become significant, short term; moderate, long term.	Same as alternative 1.	Potential to become significant, short term; moderate, long term.[1]
Socioeconomics			
Impacts on employment, personal income, and population in Gillette and Campbell County.	Moderate through 2005 (short term); potential to become significant beyond 2005 (short and long term).	Same as alternative 1.	Moderate through 2005 (short term); potential to become significant beyond 2005 (short and long term).[1]
Impacts on housing in Gillette and Campbell County, including impacts to property values in the Garner Lake housing development.	Minor, short and long term.	Same as alternative 1.	Minor, short and long term.[1]
Impacts on the public-sector fiscal conditions of Gillette, Campbell County, and the Campbell County School District.	Minor, short and long term.	Same as alternative 1.	Minor, short and long term.[1]
Impacts on social well-being in Gillette and Campbell County.	Minor and positive, short term; minor and negative, long term.	Same as alternative 1.	Minor and positive, short term; minor and negativ long term.[1]

Table IV-5.--Comparison by alternative of the intensity and duration of cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Recreation			
Impacts on public-recreation facilities and services in (1) Gillette, (2) Campbell County, and (3) Keyhole State Park.	(1) and (2) Minor, short and long term. (3) Potential to become significant, short term; minor, long term.	(1), (2), and (3) Same as alternative 1.	(1) and (2) Minor, short and long term.[1] (3) Potential to become significant, short term; minor, long term.[1]
Transportation			
Impacts of increased traffic on public safety and traffic flow (1) in and (2) around Gillette.	(1) Minor, short and long term. (2) Potential to become significant, short term; minor, long term.	(1) Same as alternative 1. (2) Same as alternative 1.	(1) Minor, short and long term.[1] (2) Potential to become significant, short term; minor, long term.[1]
Impacts of increased coal-train traffic on public safety and automobile-traffic flow at at-grade railroad highway crossings.	Moderate, short term; minor, long term.	Same as alternative 1.	Moderate, short term; minor, long term.[1]
Cultural resources			
Direct and indirect impacts to historic and prehistoric sites on or adjacent to the life-of-mine area.	Minor, permanent.	Same as alternative 1.	Minor, permanent.[1]
Impacts to undiscovered cultural-resource sites.	Potential to become significant, permanent.	Same as alternative 1.	Potential to become significant, permanent.[1]

Table IV-5.--Comparison by alternative of the intensity and duration of cumulative impacts that would result from mining the six existing and two proposed surface coal mines north and east of Gillette, Wyoming--Continued

Impact topic by environmental resource	Intensity and duration of cumulative impact		
	Alternative 1	Alternative 2	Alternative 3
Visual resources			
Impacts to visibility (1) in the Gillette, Wyoming, area and (2) at Devils Tower National Monument from increased particulate and diesel-emission levels.	(1) Minor, short term; negligible, long term. (2) Negligible, short and long term.	(1) Same as alternative 1. (2) Same as alternative 1.	(1) Minor, short term; negligible, long term.[1] (2) Negligible, short and long term.[1]

[1]The intensity of the impact identified under this alternative is less than the intensity identified fo alternative 1; however, the reduction is not great enough to move it into the next lower level o intensity.

CHAPTER V

CONSULTATION AND COORDINATION, PUBLIC PARTICIPATION, AND REVIEW

A. CONSULTATION AND COORDINATION

In the course of processing PPC's permit application for its proposed Dry Fork mine, OSMRE consulted/coordinated with a variety of agencies.

The Land Quality Division of Wyoming DEQ was contacted regarding the review and evaluation of PPC's permit application. It provided consultation on and analysis of environmental and mining matters covered in the EIS. In conjunction with the review of the permit application, it ensured compliance with the Wyoming Environmental Quality Act (WEQA), prepared findings, and prepared the supporting documentation, the supplementary report, and the cumulative hydrologic impact assessment evaluating potential environmental impacts of the project.

Wyoming Game and Fish Department was contacted to provide consultation on wildlife matters.

The State Historic Preservation Officer of the Wyoming State Archives, Museums, and Historical Department was contacted regarding the cultural and historic resources in the area.

The Casper District Office of BLM was contacted to ensure its participation as a cooperating agency for this EIS. As a cooperating agency, the office provided consultation on environmental matters and detailed review of and comment on the adequacy of the EIS for surface leasing, right-of-way, and mining plan/resource recovery and protection plan purposes. The office was contacted regarding the formal review of the resource recovery and protection plan part of PPC's permit application, identification of conditions on the Federal coal leases, and determination of postmining land use conflicts.

The Ecological Services Division (Cheyenne, Wyoming, office), USFWS, was contacted regarding the raptor and fish resources of the area.

The Endangered Species Field Office (Helena, Montana), USFWS, was contacted regarding the Federal threatened and endangered species that could inhabit or otherwise use the proposed Dry Fork mine permit area.

B. PUBLIC PARTICIPATION

A formal period for submittal of written comments regarding the scope of the EIS analysis occurred from February 26, 1985, through March 28, 1985. OSMRE published a notice of intent to prepare a draft EIS on the Dry Fork mine proposal, including a request for public participation in determining the scope of the issues to be addressed in that EIS, in the February 26, 1985, Federal Register (50 F.R. 7841). Three comment letters on the scope of the EIS analysis were received. OSMRE held a public meeting on March 13, 1985, in Gillette, Wyoming, to obtain public input concerning the proposed mine in general and any significant issues in particular that the public felt an EIS on the proposed mine should address. Twelve

people, nine of whom presented comments, attended the meeting. Numerous impact topics regarding the applicant's proposal were identified during these scoping activities. Many of these topics were evaluated as part of the impact analysis of the EIS (chapter IV). Those topics not formally addressed are discussed in section C of this chapter along with OSMRE's rationale for not including them in the analysis.

OSMRE released a draft of the EIS for public review and comment on April 11, 1988. Formal public notice of the availability of the draft EIS was published by OSMRE in the April 19, 1988, issue of the Federal Register (53 F.R. 12830) and by the Environmental Protection Agency (EPA) in the April 29, 1988, issue of the Federal Register (53 F.R. 15461). Seventeen comment letters regarding the EIS were received during the 60-day comment period ending on June 13, 1988. OSMRE suggested that a formal public comment meeting on the draft EIS could be held during the comment period in Gillette, Wyoming, if substantial interest was shown. No interest in such a meeting was expressed.

Written comments received during the public comment period were carefully considered in the preparation of this final EIS. All of the substantive comments have been summarized and specific responses from OSMRE have been prepared. (Please refer to appendix C for both the comment summaries and the agency response.)

The EIS is available for public review at the OSMRE address shown on the cover sheet as well as at OSMRE, Casper Field Office, 100 East B Street, Federal Building, Room 2128, Casper, Wyoming 82601-1918, and at Wyoming DEQ, 122 West 25th Street, Herschler Building, Third Floor, Cheyenne, Wyoming 82002.

After OSMRE publishes this final EIS, the Secretary of the Interior must make a decision whether to approve or disapprove PPC's mining plan. The Secretary can make this decision no sooner than 30 days following publication of EPA's Federal Register notice of the availability of the final EIS.

C. PUBLIC ISSUES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

For various reasons, OSMRE evaluated but determined not to address a few of the topics concerning the applicant's proposal that were identified by the public during scoping activities. A list of these topics, along with OSMRE's rationale for not analyzing them, follows:

- Redesigning the final contour of the mine area to include a water retention reservoir for recreational purposes.--The public believes that (1) PPC could redesign the postmining contour of the mine area to include a lake for recreational purposes and that (2) such a lake would increase the opportunities for recreation near Gillette. PPC proposes to construct five stock ponds after mining in the general location of existing stock ponds that would be disturbed by mining. (See figure A-2 in appendix A.) However, PPC does not propose to construct a recreational lake. For this reason, and because Federal regulation includes no provision for requiring construction of such a lake, OSMRE has not identified and analyzed probable impacts to the environment of redesigning the final contour of the mine area to include a water retention reservoir.

- Implementing the "slurry trench" approach to protect the scoria aquifer.--The public believes that PPC could construct a slurry wall between the Dry Fork mine pit and Moyer Springs to protect the scoria aquifer. A slurry wall is a bentonite-filled trench, commonly dug with a backhoe or clamshell, that constitutes an impermeable barrier to ground-water flow. Bentonite slurry and soil are backfilled into the trench as it is being dug to prevent its walls from collapsing. Slurry trenches are typically used in shallow unconsolidated strata; it is difficult, if not impossible, to excavate a slurry trench into the material present in the proposed Dry Fork mine area, particularly at the depths that would be required. It would also be difficult, if not impossible, to remove a slurry trench after the completion of mining. For these reasons, OSMRE considers a slurry trench to be technologically infeasible at the proposed Dry Fork mine and has not identified and analyzed probable impacts to the environment of implementing the slurry trench approach to protecting the scoria aquifer.

- Endangered or threatened wildlife species protected by the Endangered Species Act of 1973.--OSMRE routinely follows procedures outlined in Section 7 of the Endangered Species Act when it reviews a proposed mining plan. Pursuant to Section 7, on January 3, 1986, OSMRE initiated consultation with USFWS, regarding PPC's permit application, by requesting from USFWS a list of protected species that could occur in the vicinity of the proposed Dry Fork mine. On January 13, 1986, USFWS responded with a list indicating that the bald eagle, the peregrine falcon, and the black-footed ferret constitute the protected species that could occur within and near the proposed Dry Fork life-of-mine area. On April 9, 1986, OSMRE prepared a biological assessment of these species. The assessment concluded that the proposed Dry Fork mine would not affect protected species named on USFWS's list. On April 23, 1986, USFWS concurred with OSMRE's determination of no effect. Because no endangered or threatened wildlife species would be affected by mining the proposed Dry Fork mine, OSMRE did not identify and analyze probable impacts to such species.

- Natural-gas seepage from coal formations below the Rawhide Village and Horizon subdivisions.--The public believes that blasting and coal seam dewatering associated with coal mining in the area north and east of Gillette is responsible for the venting of natural gases (i.e., methane, hydrogen sulfide, and hydrogen selenide gases) from the underground coal seam into these residential areas. Federal and State investigators have been unable to find any direct correlation between the mining of coal north and east of Gillette, including proposed mining at the Dry Fork mine, and the natural-gas venting problem. Studies, however, are continuing. OSMRE considers this topic to be beyond the scope of the analysis at this time and therefore did not identify and analyze probable impacts associated with the topic.

- Public water supply and wastewater treatment facilities, law enforcement and fire protection personnel needs, public education facilities, human services staff, and health care facilities.--The public believes that additional coal development north and east of Gillette could strain the ability of the city of Gillette and of Campbell County to provide necessary public services. OSMRE contracted with Richardson Associates of Denver, Colorado, to evaluate the socioeconomic conditions in Campbell County and to determine what effects, if any, continued coal development would have on the area's capability to provide services. In general, Richardson Associates concluded

that impacts would be minor, with only a few exceptions, and that the area should be capable of providing all necessary services well in advance of the need for them (Richardson Associates, 1985). Discussions of those socioeconomic issues considered by OSMRE to provide the reader and the decisionmaker with a better understanding of the possible consequences of mining north and east of Gillette are included in chapter IV. Discussions of all other socioeconomic issues are available for review at OSMRE, Western Field Operations, 1020 - 15th Street, Brooks Towers, Second Floor, Denver, Colorado.

- Mining activity within 100 feet of the scoria aquifer discharge area.--The public believes that irreversible impacts would occur to the scoria aquifer and its recharge zone if mining is allowed to take place within 100 feet of its discharge area at Moyer Springs. OSMRE's analysis found that both the scoria aquifer proper and its recharge zone are separate and distinct from the aquifer's discharge area (i.e., Moyer Springs and Moyer Springs Creek). Mining within 100 feet of the scoria aquifer's discharge area, as would occur at the proposed Dry Fork mine, would affect neither the physical properties of the aquifer and its recharge zone nor the recharge rate of the scoria aquifer. As a result, OSMRE did not identify and analyze probable impacts from such a situation.

D. REVIEW

This EIS has been mailed to all parties who have expressed an interest in it, as well as to all those from whom comments were solicited. Additional copies of the document are available on request for a limited time from OSMRE at the OSMRE address shown on the cover sheet. OSMRE mailed copies of the EIS to:

Department of the Interior

Bureau of Land Management, Buffalo, Wyoming
Bureau of Land Management, Casper, Wyoming
Bureau of Land Management, Cheyenne, Wyoming
Bureau of Land Management, Craig, Colorado
Bureau of Land Management, Denver, Colorado
Bureau of Land Management, Washington, D.C.
Bureau of Mines, Denver, Colorado
Bureau of Mines, Washington, D.C.
Bureau of Reclamation, Billings, Montana
Bureau of Reclamation, Denver, Colorado
Bureau of Reclamation, Washington D.C.
National Park Service, Denver, Colorado
National Park Service, Devils Tower, Wyoming
National Park Service, Washington D.C.
U.S. Fish and Wildlife Service, Cheyenne, Wyoming
U.S. Fish and Wildlife Service, Denver, Colorado
U.S. Fish and Wildlife Service, Helena, Montana
U.S. Fish and Wildlife Service, Washington D.C.
U.S. Geological Survey, Cheyenne, Wyoming
Office of Environmental Project Review, Denver, Colorado
Office of Environmental Project Review, Washington, D.C.
Office of the Solicitor, Denver, Colorado
Office of the Solicitor, Washington, D.C.

Other Federal agencies

Department of the Army:
    Corps of Engineers, Omaha, Nebraska
Department of Agriculture:
    U.S. Forest Service, Washington, D.C.
    U.S. Soil Conservation Service, Casper, Wyoming
    U.S. Soil Conservation Service, Washington, D.C.
Department of Energy, Lakewood, Colorado
Department of Energy, Washington, D.C.
Department of Health and Human Services, Denver, Colorado
Department of Housing and Urban Development, Denver, Colorado
Department of Housing and Urban Development, Washington, D.C.
Department of Labor:
    Mine Safety and Health Administration, Denver, Colorado
    Mine Safety and Health Administration, Washington, D.C.
Department of Transportation, Denver, Colorado
Environmental Protection Agency, Denver, Colorado
Environmental Protection Agency, Washington, D.C.
Federal Energy Regulatory Commission, Washington, D.C.
Interstate Commerce Commission, Washington, D.C.

State legislators

Representative Michael Enzi, Gillette, Wyoming
Representative John Hines, Gillette, Wyoming
Representative Earl R. Wallis, Gillette, Wyoming
Senator Kelly Mader, Gillette, Wyoming
Senator John Perry, Buffalo, Wyoming

Federal legislators

Representative Richard Cheney, Cheyenne, Wyoming
Senator Alan K. Simpson, Cheyenne, Wyoming
Senator Malcolm Wallop, Cheyenne, Wyoming

Libraries

George Amos Memorial Library, Gillette, Wyoming
Colorado State University Library, Fort Collins, Colorado
Denver Public Library, Denver, Colorado
Library of Congress, Washington, D.C.
Linda Hall Library, Kansas City, Missouri
University of Wyoming Library, Laramie, Wyoming
USGS Library, Washington, D.C.
Wyoming State Library, Cheyenne, Wyoming

State of Wyoming

Department of Environmental Quality:
    Air Quality Division, Cheyenne, Wyoming
    Land Quality Division, Cheyenne, Wyoming
    Water Quality Division, Cheyenne, Wyoming

State of Wyoming--Continued

Department of Health and Social Services, Cheyenne, Wyoming
Game and Fish Department, Cheyenne, Wyoming
Geological Survey of Wyoming, Laramie, Wyoming
Office of Industrial Siting Administration, Cheyenne, Wyoming
Office of State Planning and Coordination, Cheyenne, Wyoming
State Archives, Museums & Historical Department, Cheyenne, Wyoming
State Engineer's Office, Cheyenne, Wyoming
Water Development Commission, Cheyenne, Wyoming

Local agencies

Campbell County Board of County Commisioners, Gillette, Wyoming
Campbell County Department of Public Assistance and Social Service, Gillette, Wyoming
Campbell County School District No. 1, Gillette, Wyoming
City of Gillette, Mayor's Office, Gillette, Wyoming
City of Gillette, Planning Office, Gillette, Wyoming

Applicant

Phillips Petroleum Company, Bartlesville, Oklahoma
Phillips Coal Company, Richardson, Texas

Private corporations/organizations

AFL-CIO, Cheyenne, Wyoming
AMAX Coal Company, Gillette, Wyoming
AMAX Exploration Company, Golden, Colorado
Anaconda Minerals Company, Denver, Colorado
Arch Mineral Corporation, Hanna, Wyoming
John T. Boyd Company, Denver, Colorado
Burns and McDonnell, Inc., Kansas City, Missouri
Campbell County Economic Development Corporation, Gillette, Wyoming
Carter Mining Company, Gillette, Wyoming
Consolidation Coal Company, Pittsburgh, Pennsylvania
Delaney and Balcomb, P.C., Glenwood Springs, Colorado
ENSECO, Incorporated, Cambridge, Massachusetts
Environmental Impact Services, Tucson, Arizona
Environmental Management Services Company, Fort Collins, Colorado
Exxon Coal and Minerals Company, Houston, Texas
Fort Union Mine Partnership, Gillette, Wyoming
Friends of the Earth, Kaycee, Wyoming
Frontier Coal Company, Gillette, Wyoming
Gillette News-Record, Gillette, Wyoming
Holland and Hart, Law Offices, Cheyenne, Wyoming
ICF Incorporated, Washington, D.C.
Izaak Walton League of America, Incorporated, Cheyenne, Wyoming
Jacobs Engineering Group, Houston, Texas
Kerr-McGee Coal Corporation, Gillette, Wyoming

Private corporations/organizations--Continued

KGWY Radio, Gillette, Wyoming
KIML Radio, Gillette, Wyoming
KOLL Radio, Gillette, Wyoming
League of Women Voters of Wyoming, Laramie, Wyoming
Middle South Services, Incorporated, New Orleans, Louisiana
National Coal Association, Washington, D.C.
National Wildlife Federation, Washington, D.C.
Planning Information Corporation, Denver, Colorado
Powder River Basin Resource Council, Sheridan, Wyoming
Powder River Coal Company, Gillette, Wyoming
Powder River Eagle Studies, Gillette, Wyoming
Public Service Company of New Mexico, Albuquerque, New Mexico
Public Service Electric and Gas Company, Hancocks Bridge, New Jersey
Radian Corporation, Austin, Texas
Shipley and Associates, Bountiful, Utah
Sierra Club, Kaycee, Wyoming
J. E. Sinor Consultants, Inc., Niwot, Colorado
Southwest Missouri State University, Springfield, Michigan
Southwest Research and Information Center, Albuquerque, New Mexico
Spring Creek Coal Company, Decker, Montana
Stone and Webster Engineering Corp., Denver, Colorado
Texaco, Inc., Denver, Colorado
Triton Coal Company, Gillette, Wyoming
UNC Naval Products, Uncasville, Connecticut
United Brotherhood of Carpenters, Portland, Oregon
Utility Fuels, Incorporated, Houston, Texas
Western Fuels Association, Incorporated, Lakewood, Colorado
Western Organization of Resource Councils, Billings, Montana
Western Water Consultants, Incorporated, Sheridan, Wyoming
Westmoreland Resources, Incorporated, Hardin, Montana
Wyodak Resource Development Corporation, Gillette, Wyoming

Individuals

Darwin F. Alt, Reston, Virginia
Russell Boulding, Bloomington, Indiana
Willard Chappell, Denver, Colorado
Peter Evans, Denver, Colorado
LeRoy Grams, Littleton, Colorado
Luther M. Krupp, Gillette, Wyoming
Matt Levar, Gillette, Wyoming
Glenn Morris, Denver, Colorado
John Morris, Denver, Colorado
Charles Peck, Denver, Colorado
S. Jim Reeves, Gillette, Wyoming
J. Sanchez, Tucson, Arizona
T. Sanders, Tucson, Arizona
John Skaggs, Gillette, Wyoming
John Sutherland, Gillette, Wyoming
Steven Youngbauer, Gillette, Wyoming

CHAPTER VI

PREPARERS AND CONTRIBUTORS

Name	Project responsibility	Education
	OSMRE	
Sarah E. Bransom	Interim socioeconomics, recreation, transportation	M.S., Planning and Community Development, University of Colorado at Denver; B.A., Political Science/ Environmental Studies, Susquehanna Univeristy
Donald G. Frickel	Hydrology	M.S., Civil Engineering, University of Nebraska; B.S., Agricultural Engineering, University of Nebraska
Gerald D. Gavette	Interim soils	M.S., Agriculature, Soils, Arizona State University; B.S., Agriculture Production and Management, Arizona State University
Duane H. Gentz	Interim technical advisor	B.S., Agronomy, Texas A&M University
Melvin L. Granberg	Technical advisor	B.S., Mining Engineering, Montana College of Mineral Science and Technology; B.S., Geological Engineering, Montana College of Mineral Science and Technology
Donald R. Henne	Interim wildlife	M.S., Wildlife Biology, University of Montana; B.S., Forestry and Wildlife, Virginia Polytechnic Institute and State University
Roger D. Highland	Graphics	Undergraduate studies, Engineering, Northeastern Junior College, Colorado

Name	Project responsibility	Education
	OSMRE—Continued	
Mark R. Humphrey	Vegetation, land use, soils	B.S., Range-Forest Management, Colorado State University
Carol B. Hurr	Technical editor, printing specialist	B.A., Secondary Education, Occidental College; Graduate studies, Geology, Colorado School of Mines
Robert D. Judy, Jr.	Wetland values	B.S., Zoology, Colorado State University; B.S., Entomology, Colorado State University; Graduate studies, Aquatic Population Ecology, North Texas State University
Foster Kirby	Cultural resources	M.A., Archeology, University of Calgary; B.S., Archeology, University of Calgary; B.A., Anthropology, Washington State University
Vernon E. Maldonado	Interim technical advisor	M.S., Business Administration, University of Phoenix at Denver; B.S., Zoology, Chemistry, University of Northern Colorado
David R. Maxwell	Air quality, climatology, visual resources	M.S., Air Pollution Control, University of Cincinnati; M.B.A., Business Management, University of Colorado at Denver; B.S., Meteorology, St. Louis University
Floyd A. McMullen, Jr.	Project management	M.S., Environmental Science, University of Colorado at Denver; B.S., Range-Forest Management, Colorado State University

Name	Project responsibility	Education
	OSMRE—Continued	
Ronald W. Naten	Wildlife	B.S., Wildlife Biology, Utah State University
Peter A. Rutledge	Management overview	Engineer of Mines, Colorado School of Mines
Jennifer Shawe	Interim editor	B.A., English, University of Denver; Graduate studies, English, University of Virginia
Ranvir Singh	Management overview	M.S., Water Quality and Water Resources, University of Iowa; M.S., Civil Engineering, University of Iowa; B.S. Civil Engineering, Aligarh Muslim University, Aligarh India
Laura B. Swatek	Geology, topography	B.S., Engineering Geology, Purdue University
Dennis D. Winterringer	Interim project manager	M.S., Wildlife Management, Auburn University; B.S., Fisheries and Wildlife Biology, Iowa State University
	BLM	
Edward C. Coy	Project coordination	B.S., Range Management, University of Wyoming; Additional studies, Physical Sciences, University of Wyoming
	J. F. Sato and Associates	
Tsegaye Hailu	Hydrology	Diploma, Hydrogeology, Hebrew University, Israel; B.S., Geology, University of Hawaii

Name	Project responsibility	Education
	Koch and Associates	
Donald Koch	Hydrology	M.S., Environmental Engineering, Stanford University; B.S., Civil Engineering, Cornell University
	Richardson Associates of Denver	
Deborah Richardson	Socioeconomics, recreation, transportation	M.S., Mining Engineering, Pennsylvania State University; B.S., Geology, Pennsylvania State Univerisity
R. Michael Stanwood	Socioeconomics, recreation, transportation	M.S., Mineral Economics, Colorado School of Mines; B.A., General Science, University of Colorado

CHAPTER VII

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APPENDIX A

SUMMARY DESCRIPTION OF THE PROPOSED DRY FORK COAL MINE

Phillips Petroleum Company (PPC) proposes to develop the Dry Fork surface coal mine in Campbell County, Wyoming, 5 five miles north and east of Gillette (fig. I-1) in sec. 6, T. 50 N., R. 71 W., sixth principal meridian; sec. 2, T. 50 N., R. 72 W., sixth principal meridian; secs. 19 and 29 through 32, T. 51 N., R. 71 W., sixth principal meridian; and secs. 23 through 26, 35, and 36, T. 51 N., R. 72 W., sixth principal meridian. The proposed life-of-mine permit area would contain a total of 3,798.49 acres, of which 2,905 acres would eventually be disturbed by mine-related operations (plate 1).

The total life of the proposed mine (the life of mine) would be 34 years: 2 years for premining development and equipment erection, 21 years to recover approximately 226,433,000 tons of coal, 1 year to complete reclamation activities, and 10 years to obtain final bond release. Coal production rates would vary from 3.0 to 15.0 million tons/yr.

A. MINE FACILITIES

The majority of facilities proposed for the Dry Fork mine would be centrally located on 61 acres in the SE¼SE¼ sec. 24 and the NE¼NE¼ sec. 25 in the northern part of the life-of-mine area (plate 1).

1. Main Facilities Building

The main facilities building would be a preengineered steel structure on a concrete foundation located in the SE¼SE¼ sec. 24 and the NE¼NE¼ sec. 25. It would house an administration office, changehouse, warehouse, a large-equipment repair shop, a small-equipment repair shop, and a first-aid station.

2. Coal Processing Facilities

Coal processing facilities would include a truck dump/crusher facility, a drivehouse, and transfer and sampling stations, all located in the NE¼NE¼ sec. 25. A silo cluster and train loadout would be located on the east side of Moyer Springs in the SW¼SW¼ sec. 19. Run-of-mine coal would be dumped into 750-ton-capacity receiving hoppers above one of four roll crushers housed in an 80-foot-deep reinforced concrete pit. A 72-inch, 480-foot-long covered conveyor would lift the crushed coal to a drivehouse, which would house a transfer tower, sampling station, baghouse, and coal laboratory. A second 72-inch, 1,280-foot-long covered conveyor would carry the coal from this drivehouse across Moyer Springs to the cluster of four storage silos. Construction of the first two 13,000-ton-capacity silos (70 feet in diameter, 265 feet high) over the outside loop of track would occur during initial development. The remaining two silos would be installed after production expands to 6.0 million tons/yr. Transfer conveyors on top of the silos would distribute coal among the silos from the main conveyor terminus.

3. Ancillary Facilities

Ancillary facilities would include fuel and lube oil storage, explosives storage, wastewater treatment, power transmission, communications, water-supply distribution and associated utility building, and a solid waste disposal site.

The fuel storage system would be located in the NW¼NE¼ sec. 25. It would accommodate 150,000 gallons of both No. 1 and No. 2 diesel in above-ground storage tanks. Gasoline (20,000 gallons), lubricants (36,000 gallons), and waste oil (6,000 gallons) would be stored in buried tanks. A Spill Prevention Control and Countermeasure (SPCC) plan would be prepared and incorporated into the construction of these tank areas, upon acceptance by the appropriate regulatory authority.

Explosives used at the mine would include bagged and bulk ammonium nitrate and fuel oil mixture (ANFO), bagged slurry blasting agents, cast primers, detonating cord, blasting caps, blasting delays, and stick dynamite. An explosives storage area would be located in the SE¼NE¼ sec. 25. Equipment within the area would include drop trailers for blasting agents and two skid-mounted explosive magazines--one for the primers and detonating cord and one for delays and blasting caps.

The wastewater system would include facilities for the collection and treatment of sewage effluent and washwater effluent. Sewage effluent flow at the mine during full production is estimated to be 20,000 gal/d. Effluent would be treated at a 30,000-gal/d package waste treatment plant located in the SE¼SE¼ sec. 24. Treated effluent would be discharged to Dry Fork Creek below Moyer Springs in the SE¼SE¼ sec. 24. Effluent would be conveyed to the treatment plant from the main facilities building via pressurized pipes and from a holding tank at the guardhouse via tank truck. Wash-down waters from the facilities, oil suspension waters, and coal dust washwaters would be collected, treated, and conveyed to one of the two lined evaporation ponds located in the SE¼SE¼ sec. 24. Solids would be regularly removed from the ponds and selectively placed in the mine backfill.

Electric power for use by the power shovels and other electrical equipment in the mine operation and at the coal handling facility and main facilities complex would be delivered by a proposed 1.5-mile, 69-kV overhead line. This line would connect the existing Tri-County Electric Association line north of the mine to a main substation located in the NE¼NE¼ sec. 25.

The communications network would include telephone services furnished by the local telephone company and business band radios. Telephone lines would be installed parallel to the electric transmission and distribution network.

The water supply and distribution system would be designed to furnish 144,000 gal/d for operational water requirements at the mine during full production. The system would be composed of one deep well, drilled into the Fort Union Formation, whose pump, water treatment equipment, and system components would be housed in a 2,400-square-foot utility building located in the NW¼NW¼ sec. 30. The system would also include a plant watermain network, a

420,000-gallon raw-water storage tank, a 20,000-gallon potable-water storage tank, and a raw-water surface reservoir for use in road dust abatement, all located in the NW¼NW¼ sec. 30. Additional water for dust suppression may be obtained from in-pit infiltration waters pumped to sedimentation ponds.

During the construction phase, solid waste would be disposed of in a 100-foot by 400-foot fenced landfill operation located in the W½ sec. 19 within the rail loop; the dumped material would routinely be covered by overburden. Once backfilling of the pit began, this solid waste would be placed in the backfill above the lower lift, not less than 4 feet from the surface. Any solid waste determined to be unsuitable for the general landfill/mine backfill and any carbonaceous material would be disposed of in the mine backfill, by using approved special handling procedures (see section C.7 of this appendix), or by a private contractor at an authorized disposal site. Permits for the construction and operation of solid waste sites would be obtained from from the Wyoming Solid Waste Division.

4. Water Control Facilities

a. Sedimentation and treatment ponds

During the life of the Dry Fork mine, PPC proposes to construct 21 sedimentation and treatment ponds to minimize mining-related contribution of sediment to the hydrologic system surrounding the mine. Fifteen temporary sedimentation ponds would be used to contain runoff from the disturbed area or water pumped from the mine pits. These ponds would eventually be mined through or reclaimed. Five permanent impoundments would initially be used to contain runoff from the disturbed area (fig. A-1). After final reclamation and bond release, these impoundments would be used for stock water and as residual sediment collectors. Sediment storage volume in the ponds would range from 0.2 to 4.9 acre-feet. Drainage area above the ponds would range from 13 to 495 acres. All impoundments would be designed to contain runoff from the 10-year, 24-hour precipitation event and would evacuate this volume within 15 days of filling. Evacuation would be accomplished by gravity flow and/or pumping. Temporary impoundment spillways would be designed to safely pass the 25-year, 24-hour runoff event; permanent impoundment spillways would be designed to safely pass the 100-year, 24-hour runoff event. Accumulated sediment would be removed from ponds when their sediment storage capacities were filled to 60 percent.

b. Hydrologic diversions and retention systems

Fifteen temporary diversion channels would be used to route runoff around active mining and to collect and intercept runoff from disturbed areas for routing to sedimentation ponds. (See plate 1 for the location of the major diversion channels.) They would be designed to contain the 10-year, 24-hour precipitation event and to transport it at mean velocities of less than 5 feet per second. Four training dikes or berms would direct flow from natural stream courses into diversion channels or prevent sheetflow from disturbed areas from crossing into undisturbed areas, or both. Containment berms would prevent the disturbed area runoff from relatively large areas having indistinct drainage channels from entering undisturbed areas. Drop structures (either gabion, culvert, or side channel type) would convey channeled water down steep drops so that (1) the remainder of the channel may cross flatter, nonerosive slopes and (2) water may be conveyed

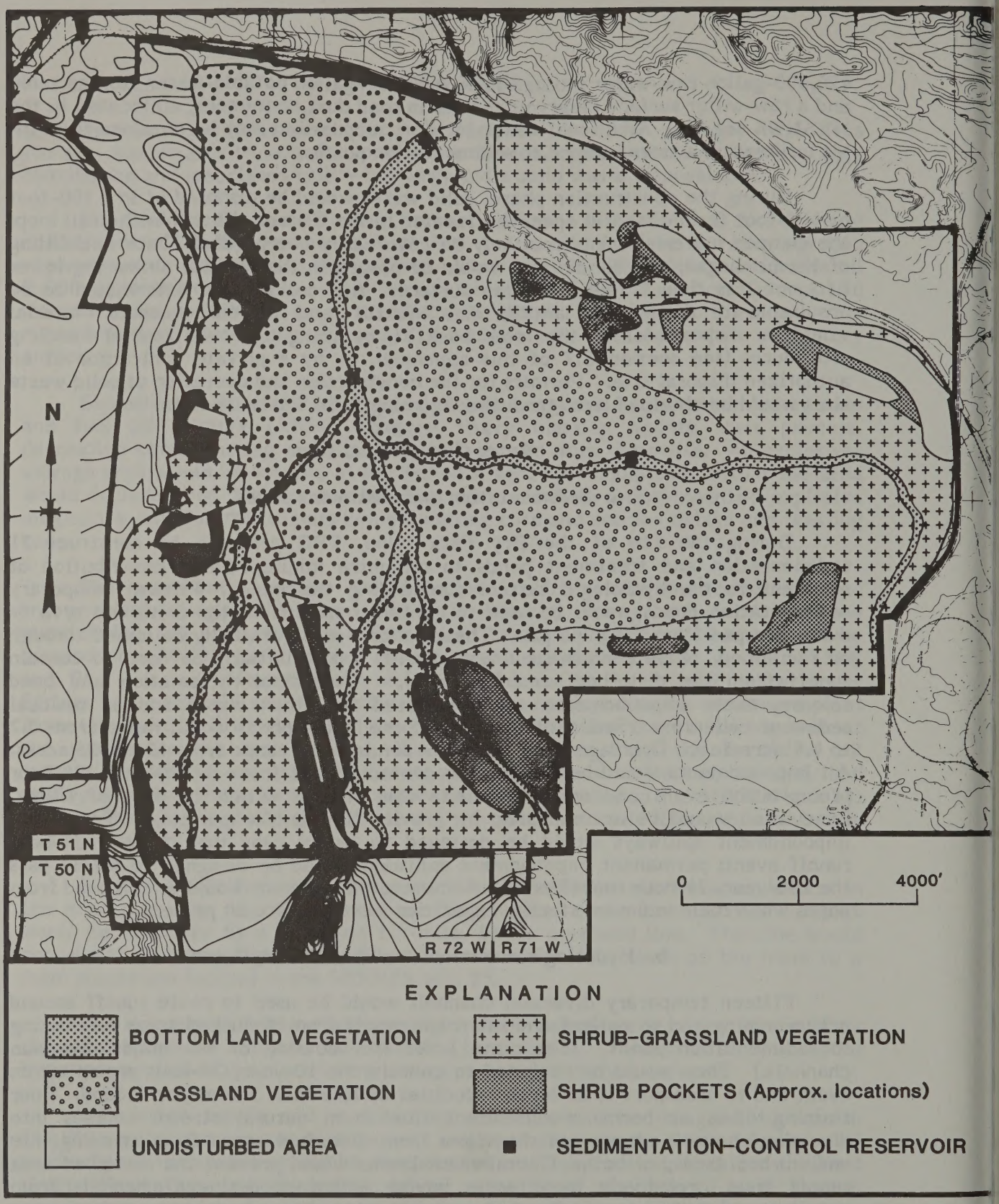

Figure A-1.--Postmining sedimentation control reservoirs and vegetation patterns. (Source: Phillips Petroleum Company, 1982-86.)

over cutslopes without scour or head cutting. Corrugated metal pipe culverts would be used at all diversion channel and natural drainage crossings for the access and mine roads and the railroad loop. All culverts would be sized to pass the peak flow of the 100-year, 24-hour precipitation event during the 20 or more years projected as their average lifetime.

B. ROADS AND RAILROADS

1. Main Access Road

The main access road would connect the main facilities area with Garner Lake Road approximately 6 miles north of its junction with State Highway 451 (plate 1). For security purposes, this road would be the only public access to the minesite. Visitors and vendors would be required to register at a security building located near the entrance to the road. The 30-foot-wide, 2-mile-long asphalt paved road would be designed to carry average daily volumes of 100 to 400 cars and 25 to 50 light trucks at a design speed of 45 miles per hour. The edges of roadcuts and fills would be designed not to encroach onto the 100-foot buffer zone surrounding Moyer Springs and its drainages.

2. Coal Haul Roads

Coal haul roads would connect the various mining operations within the mine area south of the facilities site. Because of the width of the 170-ton end-dump trucks to be used at the Dry Fork mine and the necessity for two-way traffic there, a 100-foot roadway with 15-foot-wide shoulders and 6-foot-high safety berms, where needed, would be constructed. Any part of a coal haul road in use for more than 12 months would be surfaced with scoria and maintained with motor graders for the life of the road.

3. Light-Use Roads

Light-use roads would be constructed throughout the mine area. They would be designed with a 20-foot road surface and 5-foot shoulders. Any light-use road in use for more than 12 months would be surfaced with scoria and maintained with motor graders for the life of the road.

4. Railroad Loop

A proposed railroad loop would be used for coal loadout at the Dry Fork mine. It would be located adjacent to Burlington-Northern Railroad Company's branch line in the S½ sec. 19 (plate 1). This branch line currently runs from the railroad company's main east-west line to the Rawhide, Buckskin, Eagle Butte, Fort Union, proposed East Gillette Federal, and Clovis Point mines north and east of Gillette. Two inbound tracks, one outbound track, three turnouts, and two weigh-in-motion scales would be constructed within the permit area to accommodate the proposed Dry Fork mine.

C. COAL MINING METHODS AND EQUIPMENT

Coal at the Dry Fork mine would be removed in four segments: the northwest area, the south advance area, the southwest area, and the east advance area (fig. A-2). Mining would begin simultaneously in both the northwest and the south advance areas in the third year of the mine and would continue in the northwest area until year 8 and in the south advance area until year 16. (See figure A-3 for the mine disturbance sequence. Note that the first year of coal removal (year 1 in figure A-3) is the third year in the life of the mine.) Operations would begin in the southwest area in year 8, when coal in the northwest area would have been depleted, and would continue until year 14. Operations would begin in the east advance area in year 16, when coal in the south advance area would have been been depleted, and would continue there until year 23. Coal to be mined is from the Canyon and Anderson seams and the carbonaceous parting between them; it averages 87 feet thick except where it has burned naturally and is partly or entirely missing. PPC holds joint backsloping/overstripping agreements for its proposed Dry Fork mine with AMAX Coal Company (for its Eagle Butte mine), with Kerr-McGee Coal Corporation (for its East Gillette Federal mine), and with Frontier Coal Company (for its Fort Union mine, pit No. 2). These agreements would allow all companies to recover coal up to their joint property lines. Because no backsloping agreement exists between PPC and the owners of the Shaw Ranch property, PPC would have to maintain a 100-foot buffer zone between the pit and the life-of-mine boundary in that area. To prevent dewatering of the scoria, PPC would also maintain a 100-foot buffer zone between the mining areas and the Moyer Springs scoria recharge zone.

1. Premining Reserve And Overburden Drill Hole Sampling Program

Coal reserves would be delineated through an intensive drilling program in advance of the pit progression. Minimum spacing for the program would be one hole per 40 acres (1,320-foot centers). Data on the physical and chemical properties of the overburden would also be collected during the drilling program in order to ensure that suitable material is replaced in the top 4 feet of regraded spoil and that any unsuitable material is properly handled. (See sections C.6 and C.7 of this appendix.) Samples would be analyzed for those properties identified by Wyoming DEQ to be detrimental to vegetation growth and water quality (e.g., texture, saturation percentage, acid-base potential, and nitrate/nitrogen content).

2. Clearing And Grubbing

Before PPC commences topsoil salvage activities, it would clear and dispose of very large shrubs or trees that would interfere with topsoil stripping.

3. Topsoil Operations

All suitable topsoil would be removed from disturbance areas prior to initiation of mining or mining-related activities. Prior to initiation of actual removal operations, the proper salvaging depth would be staked under the supervision of a qualified person. Salvage depth information would be used by equipment operators. Topsoil would be removed to a depth of from 0.7 to 5.0 feet, depending on the site. Salvaged topsoil would be hauled directly to recontoured areas whenever practicable to keep handling and stockpiling to a minimum. Whenever quantities of topsoil in excess of the direct hauling requirements are

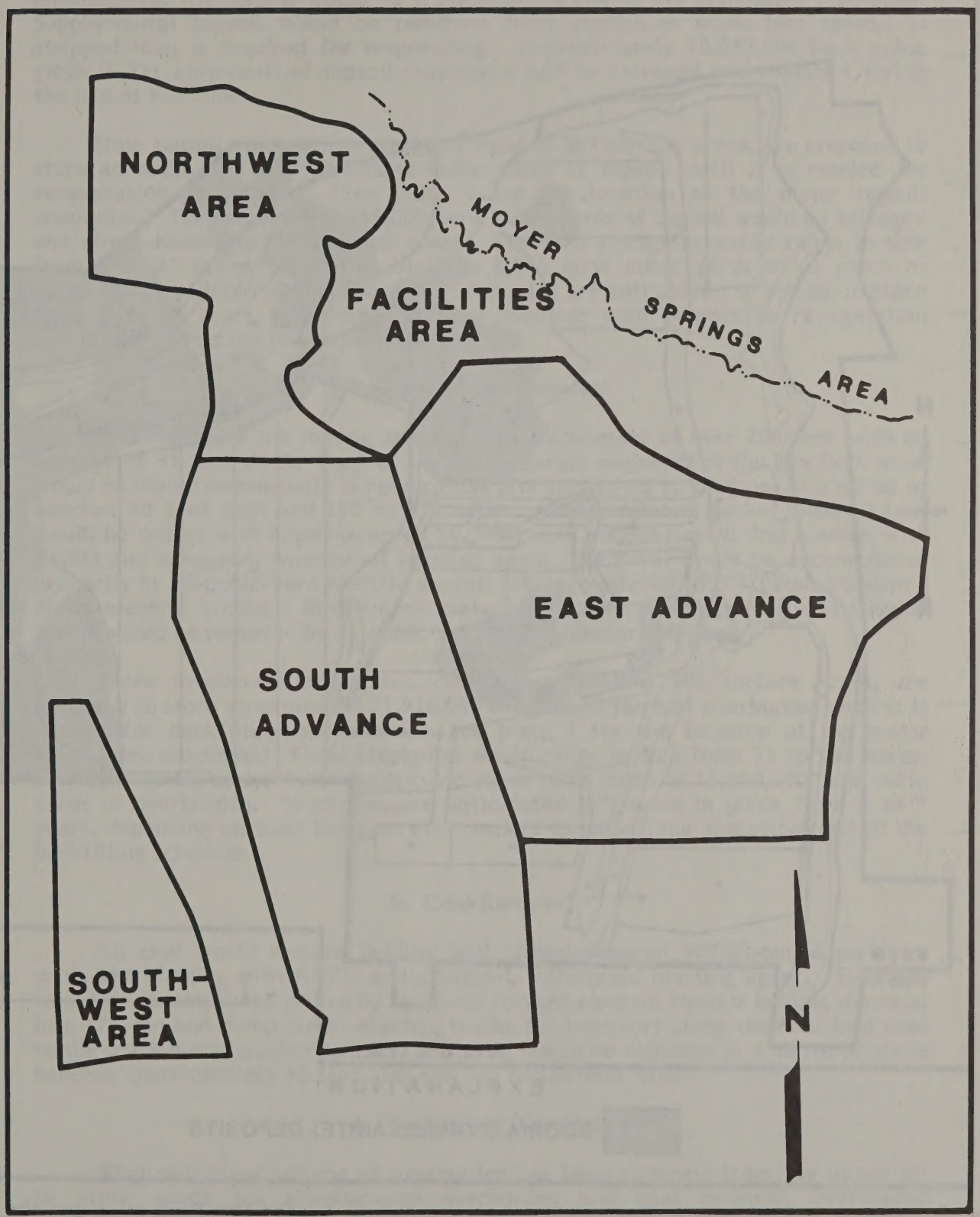

Figure A-2.--The four mining areas proposed within the Dry Fork life-of-mine area. (Source: Phillips Petroleum Company, 1985-86.)

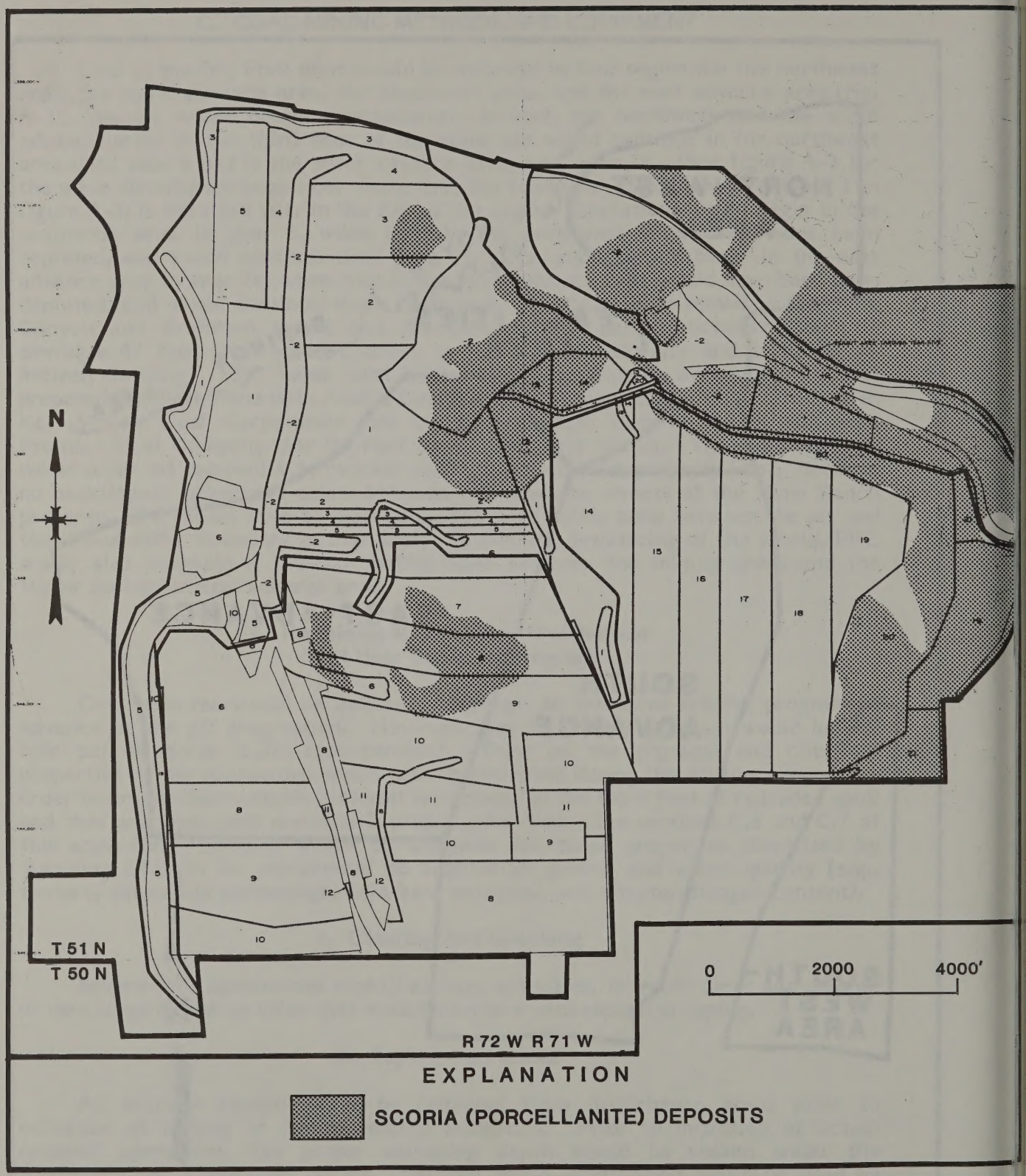

Figure A-3.--The life-of-mine disturbance sequence for the Dry Fork mine and the location of scoria (porcellanite) deposits within the the life-of-mine area and vicinity. (Source: Phillips Petroleum Company, 1985-86.)

encountered, the surplus would be transported to one of the designated stockpiles. Supplemental topsoil would be removed from stockpiles when less topsoil is stripped than is required for respreading. Approximately 10,053,000 bank cubic yards (6,231 acre-feet) of topsoil material would be salvaged and replaced during the life of the mine.

Nine topsoil stockpiles, covering a total of 209 surface acres, are proposed to store an estimated 6,504,000 bank cubic yards of topsoil until it is needed for revegetation operations. (See plate 1 for the location of the major topsoil stockpiles.) The remaining 3,549,000 bank cubic yards of topsoil would be salvaged and direct-hauled to reclamation areas. The nine stockpiles would range in size from 2 to 45 acres, holding as little as 8,000 bank cubic yards to as much as 2,140,000 bank cubic yards of topsoil. Stockpiles are anticipated to remain in place from 1 to 28 years, depending on their location with respect to revegetation operations and on the revegetation schedule.

4. Overburden Removal

Overburden in the mining area reaches thicknesses of over 200 feet with an average of 95 feet thick. Each of the four separate segments of the Dry Fork mine would be mined sequentially in rectangular pits excavated to the coal in a series of benches 40 feet high and 120 to 150 wide. All overburden thicker than 40 feet would be drilled with diesel-powered 40,000-pound pulldown drills and blasted with ANFO and a bagged, waterproof blasting agent. Removal would be accomplished primarily by 26-cubic-yard electric shovels loading material into 170-ton end-dump diesel-electric trucks. Interburden material between the Anderson and Canyon seams would be removed by 31-cubic-yard wheel-tractor scrapers.

Three overburden stockpiles, covering a total of 281 surface acres, are proposed to store an estimated 21,916,000 bank cubic yards of overburden until it is needed for backfilling operations. (See plate 1 for the location of the major overburden stockpile.) These stockpiles would range in size from 35 to 145 acres, holding as little as 1,504,000 bank cubic yards to as much as 11,600,000 bank cubic yards of overburden. Stockpiles are anticipated to remain in place from 4 to 7 years, depending on their location with respect to backfilling operations and on the backfilling schedule.

5. Coal Removal

All coal would require drilling with diesel-powered 40,000-pound pulldown drills and blasting with ANFO and a bagged, waterproof blasting agent. Removal would be accomplished primarily by 26-cubic-yard electric shovels loading material into 170-ton end-dump diesel-electric trucks for transport along the coal haul road to the truck dump/crusher facility. Material would be removed in a series of three benches approximately 40 feet high and 120 to 150 feet wide.

6. Backfilling (General)

When sufficient volume of overburden has been removed from the initial pit to allow space for simultaneous overburden and coal removal, overburden excavated from the leading edge of the active pit would be hauled to the back of the initial pit for backfilling. Thus, in effect, the pit would advance. Rough backfilling would be completed as soon as possible after coal removal. In the active backfill area, a working bench of 120 to 150 feet would be required for each

50 feet backfilled. Highwalls would be eliminated by backfill operations with contours established so that slopes are less than 3.5h:1.0v. All other slopes on the reclaimed land would be constructed to be compatible with the adjoining undisturbed areas and the postmining land use. The top 4 feet of overburden would be composed of material suitable for revegetation.

7. Backfilling (Special Handling)

Certain unsuitable material in the spoil (i.e., highly carbonaceous units, acid-forming material, and the coal rider seams (together, approximately 19,050,000 bank cubic yards) would be selectively handled; this material would be placed in designated areas at the base of the pit, entombed by an impermeable layer of other material (such as claystone), and compacted within 30 days to limit its contact with the surrounding environment. Marginally suitable material in the spoil would also be selectively handled; it would be placed in designated areas below the vegetation rooting zone, above the ground-water potentiometric surface, and outside the area of drainage channels or their flood plains.

PPC has proposed a plan to sample regraded spoil on 300-foot centers to a depth of 4 feet to ensure that no unsuitable spoil is overlooked. The samples would be composited into upper 2-foot and lower 2-foot samples. Each of these composited samples would be analyzed for pH, conductivity, and acid-base potential. Should any spoil prove unsuitable for revegetation, PPC would likely conduct additional sampling to locate the area of unsuitable material. Deep ripping and blending, adding supplements, or removing the unsuitable portion of the spoil and replacing it with suitable overburden are methods PPC could use to eliminate any such areas.

8. Topsoil Replacement

Topsoil would be spread uniformly to a depth of approximately 26 inches after backfilled spoil had been graded to slightly more than 2 feet below the final elevation and deep ripped on the contour. After it is respread, the topsoil would be graded to the final contours required to establish the postmining topography. Replacement would be accomplished by scrapers, and grading would be accomplished by rubber-tire graders. To prepare an adequate seedbed, the soil would be tilled after final grading operations are complete.

9. Overburden Borrow Areas

In year 23, the final pit would be backfilled by grading the north and east highwalls of the east advance area into the pit. This procedure would include excavation of approximately 13,443,000 bank cubic yards of borrow material outside the primary pit area in the W½ sec. 29 and the NW¼ sec. 32 to create a more suitable set of postmining contours.

10. Scoria Borrow Areas

Dry Fork mining operations would require approximately 3.8 million bank cubic yards of scoria material over the life of the mine for construction and haul-road maintenance. Several large scoria deposits exist within the life-of-mine area (fig. A-3).

Three types of scoria mining operations would occur during the life of the mine. First, in year 1, scoria excavated during construction of the truck/dump/crusher facility area would be used for fill at the main facilities area. Second, during years of operation when scoria is available in the active mine pit as overburden, it would be segregated for any maintenance needs. Third, in years when scoria is not available from an active overburden removal operation, a dedicated scoria pit, anticipated to lie immediately south of the facility area (in secs. 25 and/or 30), would provide the material requirements. Actual mining would be accomplished by ripping with a dozer and loading into overburden trucks with a front-end loader. No blasting, crushing, or stockpiles are planned. The scoria would be used run-of-mine from working bench levels.

D. RECLAMATION PLAN

The mining and reclamation plans are interdependent in that they were designed to assure that reclamation for each mined area might be performed at the earliest possible time. Although the distance that reclamation would follow mining would vary considerably with the size and shape of the active pits, a reasonable generalization is that topsoil would be replaced on contoured spoil about 2,000 feet behind the face of the advancing pit. Topsoil salvaging and replacement operations would be separated by about 3 years--topsoil would be salvaged 1 year in advance of mining; mining would require 2 additional years. Mining, reclamation, and bond release at any given point would proceed as follows:

Year 1 - Topsoil removal

Year 2 - Overburden removal; coal removal

Year 3 - Open pit used for mining operations; backfill

Year 4 - Backfilling; regrading; topsoil replacement; recontouring; drainage control; bond release (not to exceed 60 percent); revegetation

Year 6 - Vegetation established; bond release (not to exceed 75 percent of bond)

Year 14 - Vegetation sampling; bond release (remaining bond amounts if reclamation requirements are fully met)

1. Postmining Land Use

Historical land uses for the Dry Fork property have been livestock production (primarily cattle) and year-round wildlife habitat. Other land uses have been hay production, oil and gas production, and recreation. Reclamation efforts at the minesite are designed to return the postmining surface estate to livestock grazing and wildlife habitat land uses.

During mining, ranching operations would be greatly reduced. Disturbed areas that are reclaimed and judged able to withstand grazing pressures would again be incorporated into ranching activities. There are no improved rangelands, croplands, or pasturelands within the proposed life-of-mine area, and none are proposed for the postmining land use. Oil and gas pipelines and public utility lines

(i.e., telephone lines and powerlines) would be relocated. Producing oil wells would be shut in and redrilled after coal mining and reclamation operations are complete.

2. Postmining Topography

Postmining elevations at the minesite would range from 4,235 feet to 4,462 feet above mean sea level. Hence, the average elevation (4,314 feet) would be 34 feet lower than the premining average elevation, reflecting the net lowering of the landscape resulting from removing the coal and recontouring the topography. Postmining slopes would range from 1 to 26 percent. The average postmining slope of 1.1 percent would be much lower than the average premining slope of 8.2 percent. Some topographic diversity would be maintained by the wide range of proposed postmining slopes. Both the lower elevations and the lower slopes would result from the small amount of available overburden materials. Restoration of a topography more nearly resembling the premining topography would not be possible owing to the restrictions of a small amount of overburden and of maximum permissible slopes.

The postmining contours would blend with adjacent premining topography except in the northwest corner of the mine area, where they would blend with the postmining contours proposed by the Eagle Butte mine. PPC would reconstruct the drainage channels for the Dry Fork Little Powder River, East Draw, West Draw, North Draw, Marshall Draw, and Dry Draw. Reclaimed channels, not necessarily intended to re-create premining cross sections, would be designed with 3:1 side slopes and sufficient capacity to carry flow from the 2-year, 24-hour precipitation event at nonerodible velocities. Floodplains would be designed to transport flow from the 100-year, 24-hour precipitation event. Additional channel stability would be achieved through a high degree of compaction and revegetation.

3. Revegetation Plan

PPC's plan to revegetate all 2,905 acres of land disturbed at the Dry Fork mine is designed to regain the productive, diverse, self-renewing, and mostly native vegetation cover that is now available across this property for livestock and wildlife. Grassland, shrub-grassland, and bottomland vegetation types would be reestablished on the life-of-mine area (fig. A-1).

All seedings would take place immediately prior to or during the most favorable period for plant growth. To take advantage of late fall, winter, and early spring moisture, fall seedings would take place from October 1 to freeze-up. Spring seedings would begin after spring thaw and continue until early May. Both drill seeding and broadcast seeding would be used at the Dry Fork mine, depending upon time of year, soil texture, vegetation species, and slope. Rates for drill seeding would range from 15 to 35 pounds of pure live seed per acre, or at least 30 seeds per square foot. Where broadcast seeding is used, seeding rates would double the rates used for drilling.

If an area were not ready for revegetation in the early spring or late fall, it would be rough-tilled and mulched. Cover crops of annual grain may be planted at rates of from 10 to 15 pounds per acre in conjunction with seedings of perennials. Mulch would be used at many reclaimed sites to protect soil and seedlings from wind erosion and to increase infiltration, reduce evaporation, reduce soil temperature, add organic matter, supply plant nutrients, and prevent water erosion. A temporary stabilizer cover of desirable annuals would be planted as a

standing mulch on all short-term disturbances of less than 1 year. During seasons when a standing mulch could not be grown, straw mulch would be used at a rate of 2 tons of clean straw or hay per acre and anchored by a crimper. Artificial mulches, such as hydromulch, rock riprap, jute netting, excelsior, and paper-net mulch, would be used when stubble or straw mulch is not sufficient.

A total of six seed mixtures are proposed for use at the Dry Fork mine. Three of the mixes (Nos. 1a, 1b, and 1c) are proposed for use in temporary revegetation. Three other mixes (Nos. 2, 3, and 4) would provide the basis for the permanent reestablishment of the major premining vegetative communities: grassland, shrub-grassland, and bottomland. The office buildings would have ornamental plants and grasses planted around them.

Seed mixture No. 1a (table A-1) is a temporary grassland mixture that would be used around facilities sites, on settling ponds, and on topsoil stockpiles with a life of more than 6 months. Temporary mixture No. 1b (table A-1) includes sod-forming species that can withstand both drought and periodic flooding for use in the basins of settling ponds and short-term diversion ditches. Mixture No. 1c (table A-1) includes mostly nonspreading annual grains for use on areas that would be disturbed less than 1 year and for use as the temporary stabilizer on final revegetation areas whenever the growing season is too short for perennials to grow.

Seed mixture No. 2 (table A-2), the general seed mix, would be the primary seed mix for all permanently reclaimed surfaces (with the exception of bottomlands) or long-term temporary disturbances. It includes a wide variety of mostly cool season grass species to take advantage of all the microenvironments and habitats proposed in the postmining topography.

Seed mixture No. 3 (table A-3), the shrub-grassland mixture, would be added to the general seed mix to provide a shrubland habitat in selected areas. After establishment of grasses and seeded shrubs, shrub plants would be interplanted at rates designed to bring shrub species up to preferred densities. Individual plants may be seedlings of containerized or bare root stock or mature shrubs transplanted using a tree spade or front-end loader.

Seed mixture No. 4 (table A-4), the bottomland mix, contains sod-forming grasses, trees, and shrubs that have some salt tolerance and would be able to withstand flooding, subirrigation, and occasional drought.

4. Revegetation Enhancement

Fertilization would be used with all seedings. Before reseeding, routine representative soil samples would be taken to determine fertilization rates.

Weeds and pests would be controlled whenever they became a major problem. Herbicides could be used, but mowing of weeds before seed maturity would be the preferred control method.

Snow fences would be temporarily installed on sites tending to be droughty or subject to wind erosion (i.e., tops of hills and windward slopes) and on sites where species diversity and seedling establishment could be aided by the concentration of winter moisture.

Table A-1.--Temporary seed mixes (Nos. 1a, 1b, and 1c) for the proposed Dry Fork mine

(Source: Phillips Petroleum Company, 1985-86)

Species	Common name	Seed mixes 1a: Temporary grassland (pounds pure live seed per acre)	1a: Seed cost[1]	1b: Diversion ditches (pounds pure live seed per acre)	1b: Seed cost[1]	1c: Seasonal temporary stabilizer (pounds pure live seed per acre)	1c: Seed cost[1]
Agropyron dasystachyum	Thickspike wheatgrass	2.0	$7.00	---	---	---	---
A. riparium	Streambank wheatgrass	---	---	3.0	$11.25	---	---
A. smithii	Western wheatgrass	3.0	8.10	2.0	5.40	---	---
A. trachycaulum	Slender wheatgrass	2.0	2.90	2.0	2.90	---	---
Aleopecurus arundinaceus	Creeping foxtail	---	---	1.0	3.50	---	---
Astragalus cicer	Cicer milkvetch	---	---	1.0	3.50	---	---
Avena sativa	Oats	---	---	---	---	12.0	$13.5(
Bouteloua gracilis	Blue grama	2.0	9.50	---	---	---	---
Bromus inermis	Smooth brome	---	---	2.0	2.30	---	---
Ceratoides lanata	Winterfat	1.0	7.00	---	---	---	---
Medicago sativa	Alfalfa	1.0	2.55	---	---	---	---
Melitotus officinalis	Yellow sweetclover	---	---	0.5	0.27	1.0	0.54
Phalaris arundinacea	Reed canarygrass	---	---	1.0	2.45	---	---

Table A-1.--Temporary seed mixes (Nos. 1a, 1b, and 1c) for the proposed Dry Fork mine--Continued

Species	Common name	Seed mixes 1a: Temporary grassland (pounds pure live seed per acre)	1a: Seed cost[1]	1b: Diversion ditches (pounds pure live seed per acre)	1b: Seed cost[1]	1c: Seasonal temporary stabilizer (pounds pure live seed per acre)	1c: Seed cost[1]
Oryzopsis hymenoides	Indian ricegrass	1.0	9.00	---	---	---	---
Sorghum bicolor	Sudan grass	---	---	---	---	12.0	4.80
Spartina pecinata	Prairie cordgrass	---	---	2.0	(2)	---	---
Stipa viridula	Green needlegrass	2.0	7.90	---	---	---	---
Thermopsis rhombifolia	Prairie thermopsis	---	---	1.0	(2)	---	---
Triticum aestivum	Winter wheat	---	---	---	---	12.0	12.95
Totals		14.0	$53.95	15.5	$31.57	37.0	$31.79

[1]Quoted prices are from Goble Seed Co., Gunnison, Utah, or Arkansas Valley Seeds, Inc.

[2]Available through native collections; prices unpublished.

Table A-2.--Grassland seed mix (No. 2) for the proposed Dry Fork mine

(Source: Phillips Petroleum Company, 1985-86)

Species	Common name	Seeding rate[1] (pounds pure live seed per acre)	Seed cost[2]
Achillea lanulosa	Western yarrow	0.1	$1.50
Agropyron dasystachyum	Thickspike wheatgrass	2.0	7.00
A. smithii[3]	Western wheatgrass	3.0	8.10
A. spicatum	Bluebunch wheatgrass	2.0	7.00
A. trachycaulum	Slender wheatgrass	2.0	2.90
Artemisia tridentata	Big sagebrush	0.25	1.12
Atriplex canescens	Fourwing saltbush	0.5	1.62
Bouteloua curtipendula	Sideoats grama	1.0	4.25
B. gracilis[3]	Blue grama	3.0	14.25
Ceratoides lanata	Winterfat	1.0	7.00
Elymus triticoides	Creeping wildrye	1.0	7.00
Oryzopsis hymenoides	Indian ricegrass	2.0	18.00
Sphaeralcea coccinea[3]	Scarlet globemallow	0.1	3.50
Stipa viridula	Green needlegrass	2.0	7.90
Total		19.95	$91.14

[1]Rates shown are for drill seeding; broadcast seeding rates would be doubled.

[2]Unless otherwise indicated, qouted prices are from Goble Seed Co., Gunnison, Utah, or Arkansas Valley Seeds, Inc.

[3]Dominant premining species in the grassland type.

Table A-3.--Shrub-grassland seed mix (No. 3) for the proposed Dry Fork mine

(Source: Phillips Petroleum Company, 1985-86)

Species	Common name	Seeding rate (pounds pure live seed per acre)	Seed cost[1]	Containerized or bare-root planting rate (seedlings/acre)
Achillea lanulosa	Western yarrow	0.1	$1.50	---
Artemisia cana	Silver sagebrush	---	---	0 to 3,000
A. frigida	Fringed sagewort	---	---	0 to 3,000
A. tridentata	Big sagebrush	0.5	2.25	0 to 3,000
Atriplex canescens	Fourwing saltbush	0.5	1.62	0 to 3,000
Ceratoides lanata	Winterfat	1.0	7.00	0 to 3,000
Chrysothamnus nauseosus	Rubber rabbitbrush	0.5	3.00	0 to 3,000
Rhus trilobata	Skunkbush sumac	0.0	7.50	0 to 3,000
Ribes cereum	Wax currant	0.5	(2)	0 to 3,000
Rosa woodii	Wood's rose	0.5	8.00	0 to 3,000
Total		4.10	$30.87	

[1]Quoted prices are from Goble Seed Co., Gunnison, Utah, 1984 listing.

[2]Available through native collections; prices unpublished.

Table A-4.--Bottomland seed mix (No. 4) for the proposed Dry Fork mine

(Source: Phillips Petroleum Company, 1985-86)

Species	Common name	Seeding rate (pounds pure live seed per acre)	Seed cost[1]	Plants/ acre)[2]
Agropyron riparium	Streambank wheatgrass	2.00	$7.50	---
A. smithii	Western wheatgrass	3.00	8.10	---
A. trachycaulum	Slender wheatgrass	2.00	2.90	---
Artemisia cana	Silver sagebrush	0.25	2.00	---
Astragalus cicer	Cicer milkvetch	1.00	3.50	---
Elymus cinereus	Basin wildrye	2.00	14.00	---
Elaeagnus angustifolia	Russian olive	---	---	0 to 20
E. triticoides	Creeping wildrye	1.00	7.00	---
Panicum virgatum	Switchgrass panic	1.00	6.50	---
Phalaris arundinacea	Reed canarygrass	1.00	2.45	---
P. sargenti	Plains cottonwood	---	---	0 to 20
Prunus virginiana	Chokecherry	---	---	0 to 20
Ribes cereum	Wax currant	---	---	0 to 20
Rosa woodsii	Wood's rose	1.00	16.00	0 to 20
Salix amygdaloides	Peachleaf willow	---	---	0 to 20
S. exigua	Coyote willow	---	---	0 to 20
Shepherdia argentea	Silver buffaloberry	---	---	0 to 20
Spartina pectinata	Prairie cordgrass	2.00	(3)	0 to 20
Thermopsis rhombifolia	Priarie thermopsis	1.00	(3)	
Total		17.25	$59.95	

[1]Quoted prices are from Goble Seed Co., Gunnison, Utah, or Arkansas Valley Seeds, Inc.

[2]Total within the reclaimed Dry Fork permit area would be 75 to 100 trees.

[3]Available through native collections; prices unpublished.

Grazing would be deferred on all areas that had been revegetated, whether with temporary or permanent seed mixes, until the plant communities were mature enough to withstand grazing pressure. Temporary, sheep-tight fences to exclude antelope and other animals would ensure protection from trampling and grazing. Grazing would normally be initiated about 3 years after seeding, although this could vary depending on the condition of the plant community. Permanent postmining fences would be built to achieve the goals of the future land management systems.

5. Wildlife Mitigation

Restoration of wildlife habitat, one of the postmining land uses, would involve the incorporation of several mitigation measures into the reclamation process as follows:

- Seven native shrub species identified as important for forage and cover for numerous types of wildlife would be included in the seed mixes (tables A-1, A-2, A-3, and A-4).

- Native shrub seedlings would be planted in concentrated pockets of varying sizes and shapes for use as wildlife forage (fig. A-2). To expedite vegetation establishment and diversity, topsoil would be hauled directly and mature vegetation pads would be transplanted.

- Five stock ponds would be replaced in the general locations of stock ponds that are to be disturbed by mining (fig. A-2). Plains cottonwood trees (Populus sargenti) for use as roosting and nesting sites for raptors and other nongame birds would be planted around the reconstructed stock ponds where water was available for adequate growth. Approximately 10 to 15 trees, each 5 to 10 feet tall, would be planted at each site. Various other tree and shrub species (table A-4) would be planted around the ponds to reduce erosion and to reestablish wildlife habitat. The headwaters of each pond would be fenced to prevent livestock abuse, to protect water quality, and to maintain vegetation cover for wildlife.

- Undulations and small hills important for habitat diversity would be designed into the regraded final topography.

- Rock piles would be placed throughout the reclaimed minesite at a density of approximately 10 to 15 rock piles per 640-acre section, depending on the availability of material. Rock piles as large as 1,000 square feet would be placed along ridges, in bottomlands, and near stock ponds to mitigate the loss of six major scoria outcrops that are used for raptor perching and mammal dens.

- Any new fences would be constructed so as not to restrict wildlife movements and migration except in hazardous or newly seeded areas.

- Powerlines would be constructed in accordance with Rural Electric Association standards designed to reduce risk of electrocution to raptors (Ollendorff and others, 1981).

- Moyer Springs Creek and the corresponding riparian habitat would be protected from disturbance. The headwaters of Moyer Springs would be fenced and a riparian buffer strip (extending 100 feet from each side of the creek) would be established for approximately 2.4 miles downstream from the headwaters. Stream channel improvements and additional plantings of adapted woody species would occur within the buffer zone.

- Raptor nests identified in the disturbance area would be mitigated in accordance with U.S. Fish and Wildlife Service (USFWS) standards. A red-tailed hawk nest located along Dry Fork Creek in sec. 25, T. 51 N., R. 72 W., would be moved to a new permanent location selected by USFWS. USFWS's criteria for selecting the new location would be that it is neither scheduled for mining nor in the immediate vicinity of a mine where the nesting pair would be disturbed. The nest would be moved sufficiently in advance of commencement of the Dry Fork mining disturbance and in such a manner as to assure that nesting by the pair would not be disturbed or interrupted.

- A black-footed ferret search would be completed within 1 year prior to disturbance of any new or existing prairie dog towns. Results would be submitted to regulatory authorities for review and clearance.

- The speed limit on all access roads would be posted at 45 miles per hour to reduce wildlife/vehicle collisions.

- Employees would be informed about Wyoming game laws and cautioned not to harass or poach game animals.

6. Facilities Reclamation

Temporary reclamation of the facilities, using various techniques to control erosion, would begin as soon as construction is complete. Permanent reclamation of any particular facility, using the same final postmining techniques as those proposed for areas disturbed by mining, would begin immediately upon the abandonment of that facility. Facilities to be permanently reclaimed would include roads, buildings, the railroad spur, and hydrologic control structures.

All structures would be dismantled and materials with any use or scrap value would be salvaged and removed from the site. Foundations, slabs, and machinery mounts of concrete would be fractured, either by mechanical means (for slab thicknesses of less than 12 inches) or by use of explosives, and buried at least 4 feet deep in the mine backfill. The facilities areas would then be graded to approximately 2 feet below the postmining contour, ripped, and topsoiled, using the same postmining techniques as those proposed for areas disturbed by mining.

7. Environmental Monitoring

A series of environmental monitoring programs would be conducted on a regular basis to both determine premining baseline environmental conditions and detect mining-related changes from the baseline values. Monitoring data would be compared with predicted mining-related changes and used, in conjunction with Wyoming DEQ and OSMRE, to design corrective measures, as necessary.

Specifically, undetected cultural resources, air-borne particulates, surface-water quality and quantity, ground-water quality chemistry, soil suitability, and revegetation success would be monitored.

E. APPROVED STATE PERMITS

1. Conditions Of The Wyoming DEQ Permit To Mine Coal

The Administrator, Wyoming Department of Environmental Quality (WDEQ), Land Quality Division (LQD), issued a Wyoming State program permit to mine the Dry Fork mine on April 10, 1987 (permit No. 599-T1). Five conditions of permit approval were attached to this permit:

- Condition No. 1.--"The operator must first obtain approval from the Secretary, U.S. Department of the Interior, prior to mining any coal owned by the United States of America."

- Condition No. 2.--"If the capacity of Moyer Springs to support trout is significantly diminished due to mine related causes, and it is not possible to restore its potential through on-site enhancement, the operator will be required to replace it by creating a similar stream environment in a suitable location within Campbell County."

- Condition No. 3.--"The operator shall conduct a column leach or other approved study to provide further site specific information on the postmining groundwater quality prior to the renewal of this permit. Detailed plans outlining the proposed methodology to be utilized in the study shall be submitted for LQD approval within six months of permit approval."

- Condition No. 4.--If at any time during the course of operations authorized by this permit, the regulatory authority determines that additional mitigation is required to prevent material damage to the hydrologic balance outside the permit area, the permittee shall propose adequate mitigation measures to the regulatory authority, and upon approval by the regulatory authority, shall implement such measures within a reasonable time frame as perscribed by the regulatory authority."

- Condition No. 5.--The permittee shall comply with W.S. 35-11-406(b)(vi), W.S. 35-11-417, and the WDEQ/LQD Rules and Regulations at Chapter XIII, Section 2 at least one hundred twenty (120) days prior to commencing any mining activities."

2. Conditions Of The Wyoming DEQ Air Quality Permit

The Director, WDEQ, and the Administrator, WDEQ, Air Quality Division, issued a Wyoming State air quality permit for the Dry Fork mine on November 19, 1986 (permit No. CT-707). Eight conditions of permit approval were attached to this permit:

- Condition No. 1.--"That authorized representatives of the Division of Air Quality be given permission to enter and inspect any property, premise or place on or at which an air pollution source is located or is being

constructed or installed for purpose of investigating actual or potential sources of air pollution, and for determining compliance or non-compliance with any rules, regulations, standards, permits or orders."

- Condition No. 2.--"That Phillips Coal Company will establish and operate an approved ambient particulate monitoring program for suspended particulate acceptable to the Division sixty (60) days prior to commencement of stripping operations. The data generated by the monitoring programs shall be submitted to the Division in an acceptable format and on a quarterly basis within 60 days of the end of each calender quarter."

- Condition No. 3.--"That all haul roads will be treated with suitable chemical dust suppressants in addition to water to control fugitive dust emissions. All treated road surfaces shall be maintained on a continuous basis to the extent that the surface treatment remains viable as a control measure."

- Condition No. 4.--"That the access road from the Garner Lake Road to the preparation plant shall be paved within 12 months of the start-construction date of the mine."

- Condition No. 5.--"That the allowable point source emission rates from the preparation plant control equipment shall be as follows:

Source	Air flow	Allowable emission	
	SCFM	lb/hr	TPY
Truck dump/crusher	51,590	4.4	15.0
Sampling station	7,500	1.3	4.4
Silos	21,000	3.6	12.2"

- Condition No. 6.--"That Phillips Coal Company shall maintain a meteorological station acceptable to the Division. Meteorological data shall be reduced and compiled in a Joint Frequency Distribution (JFD) using the modified sigma theta method for stability. A JFD shall be submitted to the Division on an annual basis."

- Condition No. 7.--"That the maximum coal production by year shall not exceed the production rate listed in Attachment I of this permit. Coal production as described in the mine plan contained in the application will be permitted through the year 2007."

- Condition No. 8.--"That Phillips Coal will submit life of mine operational parameters such that year by year emission inventories can be calculated. The data is required to be submitted within 60 days of the issuance of this permit."

APPENDIX B

SUMMARY DESCRIPTION OF CUMULATIVE COAL DEVELOPMENT NORTH AND EAST OF GILLETTE

This appendix summarizes the life-of-mine scenarios for the six existing mines (AMAX Coal Company, Eagle Butte mine; Carter Mining Company, Rawhide mine; Frontier Coal Company, Fort Union mine; Kerr-McGee Coal Corporation, Clovis Point mine; Triton Coal Company, Buckskin mine; and Wyodak Resource Development Corporation, Wyodak mine) and one proposed mine (Kerr-McGee Coal Corporation, East Gillette Federal mine) currently operating or proposed for operation in the immediate vicinity of the proposed Dry Fork life-of-mine area (plate 2) north and east of Gillette. Specifically, this appendix abstracts the mining plans for each of these seven mines (AMAX Coal Company, 1981-86; Carter Mining Company, 1981-86; Frontier Coal Company, 1983-85; Kerr-McGee Coal Corporation, 1981-86a, b; Triton Coal Company, 1978-84; and Wyodak Resource Development Corporation, 1981-86). Cumulative acreage and coal production totals are included in chapter I in table I-3.

A. BUCKSKIN MINE (TRITON COAL COMPANY)

Triton Coal Company is currently operating the Buckskin surface coal mine 11 miles northwest of Gillette and 4 miles northwest of the proposed Dry Fork mine (plate 2) in secs. 4, 5, and 6, T. 51 N., R. 72 W., sixth principal meridian, and secs. 31, 32, and 33, T. 52 N., R. 72 W., sixth principal meridian. The Buckskin life-of-mine area contains a total of 1,467.0 acres, of which 1,315.0 acres will have been disturbed by mine-related activities upon completion of mining.

1. Coal Mining

The Buckskin mine began prestripping operations (construction activities) in July 1980. Triton Coal Company anticipates the total life of the mine to be 27 years (17 years for mining and reclamation operations and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure that revegetation is complete). The remaining life of the mine would be 19 years (1988-2007). Coal production at the mine would cease in 1996; all structures would be removed, and the postmining reclamation would be completed in 1997. Total recoverable reserves calculated through 1996 are estimated at 79 million tons of coal. Coal-production rates are planned to vary from 0.972 (1996) to 6.181 million tons/yr (1986). All coal produced is shipped from a private rail spur that connects to Burlington-Northern Railroad Company's Gillette north branch line.

2. Reclamation

Historical land uses for the Buckskin minesite have been rangeland grazing and wildlife habitat, with limited acreages committed to hay and small-grain production. Postmining reclamation efforts at the minesite will return the entire disturbed area to grazingland and wildlife habitat.

B. CLOVIS POINT MINE (KERR-MCGEE COAL CORPORATION)

Kerr-McGee Coal Corporation is currently operating the Clovis Point surface coal mine approximately 3 miles northeast of Gillette and 2 miles southeast of the proposed Dry Fork mine (plate 2) in secs. 7, 8, 9, 10, 11, 15, 16, 21, and 22, T. 50 N., R. 71 W., sixth principal meridian. The Clovis Point life-of-mine area contains a total of 1,370.83 acres, of which 1,067.1 acres will have been disturbed by mine-related activities upon completion of mining.

1. Coal Mining

The Clovis Point mine began prestripping operations in February 1977. Kerr-McGee Coal Corporation anticipates the total life of the mine to be 35 years (25 years for mining and reclamation and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure that revegetation is complete). The remaining life of the mine would be 24 years (1988-2012). Coal production at the mine would cease in the year 2000, and the regrading and topsoil replacement would be complete in 2002. Total recoverable reserves calculated through the year 2000 are estimated at 76,384,440 tons of coal. Coal production rates are planned to vary from 0.3 (1979) to 4.3 million tons/yr (1984-87). All coal produced is shipped from a private rail spur that connects to Burlington-Northern Railroad Company's Gillette north branch line.

2. Reclamation

Historical land uses for the Clovis Point minesite have been livestock grazing and wildlife habitat. Postmining reclamation efforts at the minesite will return the entire disturbed area to these same premining uses.

C. EAGLE BUTTE MINE (AMAX COAL COMPANY)

AMAX Coal Company is currently operating the Eagle Butte surface coal mine approximately 5 miles northeast of Gillette and immediately west of the proposed Dry Fork mine (plate 2) in secs. 8, 9, 10, 15, 16, 17, 20, 21, 22, 23, 26, 27, 28, 34, and 35, T. 51 N., R. 72 W., sixth principal meridian. The Eagle Butte life-of-mine area contains a total of 5,229.16 acres, of which 4,759.0 acres will have been disturbed by mine-related activities upon completion of mining.

1. Coal Mining

The Eagle Butte mine began prestripping operations (construction activities) in 1976; overburden removal began in February 1977. AMAX Coal Company anticipates the total life of the mine to be 45 years (35 years for mining and reclamation and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure that revegetation is complete). The remaining life of the mine would be 33 years (1988-2021). Coal production at the mine would cease in the year 2009, and the regrading and topsoil replacement would be complete in 2011 (estimated). Total recoverable reserves calculated through 2009 are estimated at 528,317,000 tons of coal. Coal production rates are planned to vary from 14.0 (1985) to 25.7 million tons/yr (1990-93). All coal produced is shipped from a private rail spur that connects to Burlington-Northern Railroad Company's Gillette north branch line.

2. Reclamation

Historical land uses for the Eagle Butte minesite have been grazinglands, pasturelands, and croplands. Wildlife use has been secondary. Postmining reclamation efforts at the minesite will return the entire disturbed area to these same premining uses.

D. EAST GILLETTE FEDERAL MINE (KERR-MCGEE COAL CORPORATION)

Kerr-McGee Coal Corporation proposes to operate the East Gillette Federal surface coal mine about 4 miles east of Gillette, immediately southeast of the proposed Dry Fork mine (plate 2) in secs. 6, 7, 8, 9, 16, 17, 20, 21, 22, 28, and 29, T. 50 N., R. 71 W., sixth principal meridian. The proposed East Gillette Federal life-of-mine area will contain a total of 3,246.15 acres, of which 2,603.5 acres will have been disturbed by mine-related activities upon completion of mining.

1. Coal Mining

The State of Wyoming issued the East Gillette Federal mine permit on February 4, 1986. The Assistant Secretary of the Interior approved the East Gillette Federal mine plan on November 3, 1986.

Kerr-McGee Coal Corporation proposes the total life of the East Gillette Federal mine to be 39 years (1986-2025; 29 years for mining and reclamation operations and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure that revegetation is complete). Although it has not yet begun development activities at the mine, Kerr-McGee Coal Corporation anticipates coal production at the mine would cease in the year 2012, and the regrading and topsoil replacement would be complete in 2015. Total recoverable reserves calculated through 2012 are estimated at 256,000,000 tons of coal. Coal production rates are planned to vary from 4.0 (1987) to 12.3 million tons/yr (2001). All coal produced will be shipped from a private rail spur that will connect to Burlington-Northern Railroad Company's Gillette north branch line.

2. Reclamation

Historical land uses for the East Gillette Federal property have been livestock grazing on native rangeland and wildlife habitat, with some dryland cropland. The southern part of the property adjoins the industrial complex of the Wyodak coal mine and powerplant. Postmining reclamation efforts at the minesite will return the entire disturbed area to grazing land and wildlife habitat.

E. FORT UNION MINE (FRONTIER COAL COMPANY)

Frontier Coal Company is currently operating the Fort Union surface coal mine approximately 3 miles northeast of Gillette, immediately south and east of the proposed Dry Fork mine (plate 2), in secs. 3, 4, 6, 7, 8, 17, and 18, T. 50 N., R. 71 W., sixth principal meridian; secs. 1, 12, and 13, T. 50 N., R. 72 W., sixth principal meridian; and secs. 20, 21, 28, 29, 31, 32, 33, and 34, T. 51 N., R. 71 W., sixth principal meridian. The Fort Union life-of-mine area contains a total of 4,645.132 acres, of which 2,454 acres will have been disturbed by mine-related activities upon completion of mining.

1. Coal Mining

The Fort Union mine began prestripping operations in April 1979. Frontier Coal Company anticipates the total life of the mine to be 52 years (42 years for mining and reclamation and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure revegetation is complete). The remaining life of the mine would be 43 years (1988-2031). Coal production at the mine would cease in the year 2019, and the regrading and topsoil replacement would be complete in 2021. Total recoverable reserves calculated through 2019 are estimated at 265,843,000 tons of coal. Coal production rates are planned to vary from 0.5 (1984) to 8.2 million tons/yr (1989-2017). All coal produced is shipped from a private rail spur that connects to Burlington-Northern Railroad Company's Gillette north branch line.

2. Reclamation

Historical land uses for the Fort Union minesite have been livestock grazing on native rangeland, wildlife habitat, and limited pastureland and cropland. Postmining reclamation efforts at the minesite will return the entire disturbed area to these same premining uses.

F. RAWHIDE MINE (CARTER MINING COMPANY)

Carter Mining Company is currently operating the Rawhide surface coal mine approximately 4 miles north of Gillette and immediately northwest of the proposed Dry Fork mine (plate 2) in secs. 2 through 17, T. 51 N., R. 72 W., sixth principal meridian, and secs. 31 and 33, T. 52 N., R. 72 W., sixth principal meridian. The Rawhide life-of-mine area contains a total of 7,393.0 acres, of which 4,921.0 acres will have been disturbed by mining-related activities upon completion of mining.

1. Coal Mining

The Rawhide mine began prestripping operations in December 1976. Carter Mining Company anticipates the total life of the mine to be 39 years (29 years for mining and reclamation and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure that revegetation is complete). The remaining life of the mine would be 27 years (1988-2015). Coal production at the mine would cease in the year 2004, and the final reclamation would be complete in 2005. Total recoverable reserves calculated through 2004 are estimated at 532.8 million tons of coal. Coal production rates are planned to vary from 1.8 (2004) to 24.0 million tons/yr (1985-2003). All coal produced is shipped from a private rail spur that connects to Burlington-Northern Railroad Company's Gillette north branch line.

2. Reclamation

Historical land uses for the Rawhide minesite have been livestock grazing, wildlife habitat, and agriculture (haylands and pasturelands). Postmining reclamation efforts at the minesite will return the entire disturbed area to these same premining uses.

G. WYODAK MINE (WYODAK RESOURCE DEVELOPMENT CORPORATION)

Wyodak Resource Development Corporation is currently operating the Wyodak surface coal mine 5 miles east of Gillette and 3 miles southeast of the proposed Dry Fork mine (plate 2) in secs. 15, 20, 21, 22, 27, 28, 29, 32, 33, and 34, T. 50 N., R. 71 W., sixth principal meridian. The Wyodak life-of-mine area contains a total of 3,273.94 acres, of which 1719.59 acres will have been disturbed by mine-related activities upon completion of mining. Two existing coal-fired powerplants (20 megawatts and 300 megawatts) are located within the life-of-mine area. The powerplants purchase coal from the mine, but neither is a part of the mining operation (i.e., neither removes coal nor undertakes reclamation).

1. Coal Mining

The Wyodak mine began mining operations in 1922. Wyodak Resource Development Corporation anticipates the total life of the mine to be 104 years (94 years for mining and reclamation and 10 years for bond release after seeding, fertilizing, irrigation, or other work to ensure that revegetation is complete). The remaining life of the mine would be 38 years (1988-2026). Coal production at the mine would cease in the year 2014, and the regrading and topsoil replacement would be complete in 2016. Total recoverable reserves calculated through 2014 are estimated at 165,280,000 tons of coal (not including an additional 30,000,000 tons mined before 1980). Coal production rates are planned to vary from 0.8 (1976) to 5.0 million tons/yr (1989-2013). Coal produced is burned at the existing mine-mouth powerplants, shipped by truck or rail from a private rail spur that connects to Burlington-Northern Railroad Company's east-west main line, or sold locally for home heating.

2. Reclamation

The historical land uses for the Wyodak minesite have been livestock grazing on native rangeland. Agricultural use, including pastureland and dryland farming, has been secondary. Postmining reclamation efforts at the minesite will return the entire disturbed area to rangeland and wildlife habitat, unless higher and/or industrial uses are indicated.

APPENDIX C

COMMENTS AND RESPONSES

Seventeen comment letters regarding the EIS were received by OSMRE during the April 11, 1988, to June 13, 1988, comment period. (See appendix E for letters.) This section contains both summaries of the substantive comments received regarding the draft EIS and responses from OSMRE to these comments.

A. AIR QUALITY

1. Comment: The commenter (letter No. 8) suggested that the EIS contain a 24-hour air quality analysis, including data on the PM_{10} national ambient air quality standard (NAAQS) and the Wyoming total suspended particulate (TSP) standard, for the Dry Fork mine/Gillette area.

Response: Air quality dispersion modeling to determine compliance with the 24-hour, PM_{10}, and TSP standards has, based on a long-standing policy, not occurred at any of the coal mines in the Gillette/Campbell County area. The Wyoming DEQ, Air Quality Division, has not been able to identify appropriate procedures for modeling short-term impacts of fugitive dust emissions from surface coal mines. They feel that facilities operating in compliance with the annual air quality standard would not likely exceed the 24-hour standard very often. As a result, Wyoming DEQ, Air Quality Division, issued an air quality permit for construction of the proposed Dry Fork mine on November 19, 1986. (See section E.2 of appendix A.) A recent extension allows the existing permit to remain in effect until August 31, 1989 (Charles A. Collins, Wyoming DEQ, Air Quality Division, Cheyenne, Wyoming, written communication, November 28, 1988). An inspection report (prepared by Wyoming DEQ, Air Quality Division) for calendar year 1987 covered the two largest surface coal mines in the vicinity of the proposed Dry Fork mine. The 24-hour TSP standards were met, based upon ambient air quality monitoring data from six sites (Dave Searle, Wyoming DEQ, Air Quality Division, Sheridan, Wyoming, oral communication to David R. Maxwell, OSMRE, Denver, Colorado, December 13, 1988). Four monitors were located on the property of the Eagle Butte mine (the larger coal producer of the two mines in 1987) and two monitors were situated on the Rawhide mine property.

B. GEOLOGY

1. Comment: The commenter (letter No. 12) suggested that the EIS include additional information concerning the coal analysis.

Response: The description of the coal resource in the Dry Fork mine area has been updated to include coal quality information. (See section B of chapter III.)

2. Comment: The commenter (letter No. 12) expressed concern that natural-gas seepage problems similar to those occurring at the Rawhide Village and Horizon subdivisions could develop in other areas.

Response: Federal and State investigators have been unable to find any direct correlation between the mining of coal north and east of Gillette and the

natural-gas seepage problem. Studies, however, are continuing. There have been no known reports of any natural-gas seepage problems affecting any other residences in Campbell County except at the Rawhide Village and Horizon subdivisions and seepage is not expected to occur in the area of either the proposed Dry Fork mine or the nearby Garner Lake subdivision. (See section B of chapter III.) If problems develop in other areas at some future point in time, they would be addressed by the appropriate authorities on a case-by-case basis. If studies show that seepage problems can be attributed to mining activity at the proposed Dry Fork mine or any other coal mine north and east of Gillette, additional restrictions on mining operations could be imposed. OSMRE considers this topic to be beyond the scope of the analysis at this time and, therefore, did not identify and analyze probable impacts associated with the topic. (See section C of chapter V.)

C. TOPOGRAPHY

No comments were received concerning the topography analysis.

D. SOILS AND OVERBURDEN

1. Comment: The commenter (letter No. 12) expressed concern with potential changes in selenium concentration after mining and its effect on revegetation success.

Response: Wyoming DEQ Guideline No. 1 (section I.B.5) requires coal mine operators to sample for, and take steps to mitigate potential problems of, high levels of selenium in the top 4 feet of regraded overburden when State personnel have reason to believe that such levels may be present. While selenium is known to exist in the southern parts of Campbell County, it has not been identified as a problem in northern parts. None of the mine operators in the area north and east of Gillette are currently being required to conduct regular selenium sampling at their minesites. Studies, however, are continuing and additional requirements could be imposed on a case-by-case basis if conditions were to change at some time in the future. OSMRE considers this topic to be beyond the scope of the analysis at this time and, therefore, did not identify and analyze any associated impacts.

E. HYDROLOGY

1. Comment: The commenter (letter No. 12) expressed concern that existing wells in the area, particularly the Shaw 1 well, would be rendered useless as a result of mining activity.

Response: OSMRE predicted that the primary impact to the Shaw 1 well would involve a 35- to 40-foot drawdown of the potentiometric head. Since this would leave approximately 80 feet of head in the well, there should be sufficient capacity to sustain the current 2 gallons per minute yield. Its viability as a source of ground water should not be affected. (See section B.5.c of chapter IV.) No other potential impacts to wells have been identified by either the public or OSMRE. In accordance with Wyoming law (W.S. 35-11-415(b)(xii)), PPC and other mine operators have committed to replacing the water supply of any property owner where the supply has been adversely affected by surface coal mining activities.

2. Comment: The commenter (letter No. 12) expressed confusion over how the presence of the augmentation well discussed under alternative 2 could "not mitigate the increase in salinity in Moyer Springs Creek and the Little Powder River that may occur after the potentiometric surface has recovered" and still have a negligible impact on the quality of water in those streams over both the short and long terms.

Response: The suggestion for the drilling of an augmentation well was directed at supplementing the flow of Moyer Springs Creek when necessary during the life of the Dry Fork mine. It would not be needed for this purpose after mining has ceased since water depletions are predicted to be less than 5 percent during that period between the completion of reclamation and the full recovery of the potentiometric surface (possibly as long as 200 years). (See section B.5.a of chapter IV.) Since (1) water quality impacts over the short term have been identified as negligible (see section B.5.b of chapter IV), and (2) PPC would have completed mining and closed the augmentation well long before the mining-related impact to Moyer Springs Creek water quality could occur (i.e., before the potentiometric surface has fully recovered), OSMRE concluded that the presence of an augmentation well during mining would have little effect on any short- or long-term water-quality-related impacts of mining activity that may occur. (See section C.1.b of chapter IV.)

3. The commenter (letter No. 12) was concerned that lowered water tables would intensify the effects of natural-gas seepage and cause shallow wells to "blow out."

Response: Federal and State investigators have been unable to find any direct correlation between the mining of coal north and east of Gillette and the natural-gas seepage problem. (See the response to geology comment No. 2 in this appendix.) Wyoming law (W.S. 35-11-415(b)(xii)) requires mine operators to replace the water supply of any property owner where the supply has been adversely affected by surface coal mining activities.

4. Comment: The commenter (letter No. 15) questioned the method used to assess the cumulative impacts of mine-facility pumpage from the Tullock aquifer, labeling it a "theoretical and totally unrealistic representation of the real world ground water system."

Response: The use of simulations to evaluate environmental impact is an accepted practice throughout the scientific community when actual data are unavailable and/or are difficult to obtain. This is particularly true when a large number of interrelated factors have the potential to influence the particular aspect of the environment under study. Many simulation techniques are available for this purpose, depending on the intensity of study that is required and the topic under analysis. The discussion concerning the analysis of ground-water pumping impacts has been revised to provide the reader with a clearer understanding of both the problem under analysis and the projected impacts. A more detailed explanation of the various ground-water simulations used in the analysis has also been included. (See section B.5.d of chapter IV.) OSMRE is satisfied that this effort was more than adequate for the immediate purpose of analyzing the impacts of coal mining in the area north and east of Gillette.

5. Comment: The commenter (letter No. 8) suggested that mining procedures should be altered to enable use of pumped water from mine pits to augment

the flow of Moyer Springs Creek when needed. The commenter felt that a reorientation of the mine pit to run parallel to the dip of the coal seam and the direction of ground-water flow would reduce the amount of ground water being intercepted by the active pit and reduce the effects on the local aquifer.

Response: Coal beds in the Campbell County area exhibit an overall regional dip toward the center of the Powder River Basin (e.g., westward). Under normal circumstances, ground-water flow would be expected to also flow westward along this regional dip. In the area north and east of Gillette, the regional dip is almost imperceptible, and the ground water in the coal/scoria aquifer tends to flow toward Moyer Springs Creek and the Little Powder River (e.g., north and east in the case of the proposed Dry Fork mine). This lack of a definable dip and the reverse flow of ground water makes true "dipline mining" inappropriate. The mining operation proposed for the Dry Fork mine does, however, incorporate many of the positive aspects usually associated with dipline mining (i.e., aligning the mine pits as much as possible in the direction of ground-water flow to minimize the amount of ground water being intercepted). The maximum reduction of flow in Moyer Springs and Moyer Springs Creek is predicted to occur only for short periods (years 3 through 7 and years 15 through 20 of coal removal at the proposed Dry Fork mine), when the mine pit would be closest to Moyer Springs, and the largest amount of pit-seepage inflow would occur. PPC's proposal includes provisions to return all pit-seepage water not used for dust control to Dry Fork Little Powder River. (See section B.5.e of chapter IV.)

6. Comment: The commenter (letter No. 8) expressed confusion over how the impact to the quality of water in Moyer Springs could be considered negligible over the long term when the TDS concentration is expected to increase "substantially" over the premining concentration.

Response: The discussion concerning the analysis of total dissolved solids (TDS) concentrations and the impacts to water quality has been revised to provide the reader with a clearer understanding of both the problem under analysis and the projected impacts. (See sections B.5.b, C.1.b, and D.5.b of chapter IV.) OSMRE's summary conclusions have also been revised to break the long-term impact into its component parts and more accurately portray the situation. (See sections B.5.b, C.1.b, and D.5.b of chapter IV.)

7. Comment: The commenter (letter No. 8) felt that the effects of reduced flow in Moyer Springs Creek appeared to be contradictory when discussions on water quality were compared to discussions on the brook trout population.

Response: In the hydrology discussion, OSMRE identified those impacts to water quality, including a potential reduction in dissolved oxygen concentrations, that might occur if flow were reduced. OSMRE concluded that mining-related activities would change the water quality of Moyer Springs Creek to only a negligible extent. (See section B.5.b of chapter IV.) In the wildlife discussion, OSMRE identified those potential impacts specific to the brook trout population if streamflow were reduced. An analysis specific to the brook trout population determined that the volume of streamflow requiring aeration at low flows was reduced sufficiently to offset potential reductions in turbulence that might occur. As a result there would not be an effect on dissolved oxygen concentrations. (See section B.7.a of chapter IV.)

F. VEGETATION

1. Comment: The commenter (letter No. 8) expressed concern with the erosional stability of the 800-foot-long 15-percent slope proposed for the postmining topography in the southeast corner of the permit area. The commenter was particularly interested in the possibility of an overstripping agreement with adjacent landowners that could lessen the overall concern.

Response: The discussion concerning the impacts of long postmining slopes on erosional stability has been revised to provide more detail on the proposed methods of erosion control and to identify existing Wyoming DEQ performance standards addressing the problem of rills, gullies, erosion, and slope stability. The discussion concerning a possible overstripping agreement has also been revised to more accurately reflect the current position of the Shaw Ranch. (See section B.3.b of chapter IV.)

2. Comment: The commenter (letter No. 8) requested more information on both the existing and future wetland characteristics and values of the Dry Fork mine area.

Response: Wetland values in the Moyer Springs and Moyer Springs Creek area are discussed in section F of chapter III and section B.6.a of chapter IV. Definitive information concerning possible wetland values present in the wet bottomland vegetation type in other sections of the proposed life-of-mine area is unavailable at this time. As a result, OSMRE has expanded the conditions of mining plan approval to eliminate the possibility that important wetland values might be overlooked. (See condition No. 9 in section A.1 of chapter II.) The various wetland discussions throughout the document have been revised accordingly. (See section F of chapter III and section B.6.b of chapter IV.)

G. WILDLIFE

1. Comment: The commenter (letter No. 11) questioned the alternative 2 restriction on fishing activity in Moyer Springs Creek, pointing out that, at some time in the future, the Wyoming Game and Fish Department could work with PPC to control the public harvest of fish without depleting the brook trout population or creating an inconvenience for mining operations.

Response: The no fishing policy along Moyer Springs Creek was primarily intended to ensure that fishing pressure did not complicate efforts to monitor the impacts of springflow reduction on the brook trout population. (See section C.3.b of chapter IV.) But OSMRE feels that Moyer Springs and Moyer Springs Creek, while protected from actual disturbance by a buffer zone, would also be too close to proposed mining-related activity to assure the safety of the general public, including recreational fisherman, until after mining-related activities have ceased. (See plate 1, in envelope.)

2. Comment: The commenter (letter No. 8) questioned the legality of the condition in Wyoming DEQ's Permit to Mine Coal, which would require PPC to create a similar stream environment in a suitable location in Campbell County should Moyer Springs capacity to support trout become significantly diminished. The commenter suggests that the cold water fishery at Moyer Springs Creek is an "existing" beneficial use and that downgrading or

removing that use would not be consistent with the State WQS and the Clean Water Act, as amended by the Water Quality Act of 1987 (CWA/WQA).

Response: PPC's proposal includes provisions to protect and enhance the quality of the riparian habitat in and around Moyer Springs Creek. (See section D.5 of appendix A.) Wyoming DEQ considers replacement of the Moyer Springs flow with associated ground water to be the worst case measure and expects the requirement to restore or replace Moyer Springs capacity to support trout, attached to the Wyoming Permit to Mine Coal (section E.1 of appendix A), to be unnecessary. Wyoming DEQ has, by including this requirement in their permit, served additional notice to PPC that the Moyer Springs system is unique and must be protected. OSMRE's analysis of coal mining-related impacts generally agrees with Wyoming DEQ's basic conclusions. (See sections B.5.a. and B.7.a of chapter IV.) Predicted maximum flow reductions in Moyer Springs Creek of 22 percent, occurring for only two short periods during coal removal operations, should not be large enough to eliminate "existing beneficial uses" associated with Moyer Springs Creek, particularly when PPC's enhancement provisions and Wyoming DEQ's "restore or replace" condition are considered. OSMRE is satisfied that all necessary steps have been taken to ensure that the existing beneficial use associated with a cold water fishery in Campbell County would remain intact for future generations.

3. Comment: The commenter (letter No. 8) questioned how Wyoming DEQ and OSMRE expect to determine when the capacity of Moyer Springs Creek to support trout is significantly diminished so that PPC would be required to replace it, per condition No. 2 of the Wyoming DEQ Permit to Mine Coal. The commenter suggested specific threshold levels of allowable impact (e.g., temperature, fish population, habitat, etc.) be established and that monitoring be required.

Response: In the analysis of coal mining-related impacts, OSMRE concluded that the short-term impact on the brook trout population in Moyer Springs has the potential to become significant if flow were reduced beyond the maximum 22 percent predicted in years 4 and 15 of coal removal at the proposed Dry Fork mine. (See sections B.5.a and B.7.a of chapter IV.) SMCRA, WEQA, and Wyoming DEQ regulations require PPC to conduct routine surface-water quality and quantity monitoring during mining operations. (See section D.7 of appendix A.) OSMRE believes that this monitoring would be sufficient to identify when flow reductions become severe (e.g., greater than 22 percent) and impacts to the brook trout population become significant.

H. SOCIOECONOMICS

1. Comment: The commenter (letter No. 6) suggested that adequate staffing for human services and health care facilities in Campbell County be accommodated as part of the Secretary's approval of the Dry Fork mining plan.

Response: The belief by the public that additional coal mining could strain the local government's ability to provide necessary public facilities prompted OSMRE to contract with Richardson Associates of Denver Colorado, to evaluate the socioeconomic conditions in the area and to determine what effects, if any, continued coal development would have on the area's capability to provide services.

In general, Richardson Associates concluded that impacts would be minor with only a few exceptions and that the area should be capable of providing all necessary services well in advance of the need for them (Richardson Associates, 1985). Assuring the adequate staffing of private and public facilities in local communities is beyond the scope of the Secretary's approval of the proposed mining plan and this analysis.

I. RECREATION

No comments were received concerning the recreation analysis.

J. TRANSPORTATION

No comments were received concerning the transportation analysis.

K. CULTURAL RESOURCES

1. Comment: The commenter (letter No. 12) questioned whether the standard condition concerning unidentified prehistoric or historic resources included previously unidentified vertebrate fossils.

Response: OSMRE interprets the instructions concerning the proper handling of unidentified prehistoric and historic resources (see section A.1 of chapter II) to include consideration of unidentified vertebrate fossils.

2. Comment: The commenter (letter No. 14) pointed out that several prehistoric and historic sites would be adversely affected by the proposed Dry Fork mine and require adequate protection through monitoring and/or mitigation.

Response: PPC has included all the prehistoric and historic sites identified by the commenter in their permit application package for the proposed Dry Fork mine. Mining operations, as proposed, would avoid as many of these sites as possible. Those sites that could not be avoided would have resulting impacts mitigated well in advance of disturbance, through an approved data recovery/mitigation plan. (See section B.11.a of chapter IV.)

L. LAND USE

1. Comment: The commenter (letter No. 1) expressed concern over the future of the three oil and gas pipelines that cross the proposed mine area.

Response: Existing oil and gas pipelines and public utility lines (i.e., telephone lines and powerlines) would be moved by PPC to a new location outside the proposed limit of disturbance at the Dry Fork mine. (See section D.1 of appendix A.) Impacts of the proposed relocation of these lines were evaluated by OSMRE and determined to be negligible. For this reason, they were not analyzed further in the EIS.

M. VISUAL RESOURCES

No comments were received concerning the visual resource analysis.

N. GENERAL

1. Comment: The commenter (letter No. 7) suggested that local government carefully review any new subdivision proposals near the Rawhide Village area to ensure that there are no potential hazards from methane or hydrogen sulfide gas seeps.

Response: Local governments are very much aware of the problems associated with natural-gas seepage below subdivisions in the areas around Gillette. Please see the response for geology comment No. 2 in this appendix. The proper planning of new housing developments in the Gillette/Campbell County area is beyond the scope of this analysis.

2. Comment: The commenter (letter No. 12) noted that the Clovis Point mine is now inactive.

Response: Many coal mines in the Gillette/Campbell County area have reduced their production levels or become inactive since 1982 and 1983 when the entire industry began experiencing a general downturn. Unfortunately, we are unable to predict when and where a resurgence in mining activity might occur. For the purposes of this analysis, impacts from coal mine activity at the eight mines north and east of Gillette, including the Clovis Point mine, have been analyzed at that hypothetical point of production when they would be most pronounced (i.e., during the full production by all mines). Impacts of coal mining with production less than maximum levels should be proportionately less than this "worst case" analysis. Prior to initiating this analysis, OSMRE made the assumptions that "market shortages/surpluses will not materially change the projected levels of development," and that "impacts to coal supply or demand (regional or otherwise) are beyond the scope of this EIS." (See section A.1 of chapter IV.)

3. Comment: The commenter (letter No. 12) had difficulty comparing the written description of the proposed mining sequence at the Dry Fork mine with the disturbance sequence depicted in figure A-3.

Response: Figure A-3 uses a numbering sequence favored by PPC that was based on the beginning of actual coal removal. The written description uses a numbering sequence, required to ensure a complete impact analysis, that was based on the life of the proposed Dry Fork mine. The discrepancy occurs because PPC proposes to use the initial 2 years of the mine life for premining development of the minesite. (See the introduction to appendix A.) Therefore, the first year of coal removal, as depicted in figure A-3 would occur in the third year of the mine. The last year of coal removal (year 21) would occur in the 23d year of the mine. The description of the mining sequence in appendix A has been expanded to explain this correlation.

4. Comment: The commenter (letter No. 8) suggested that the EIS should include more detail on the specific types of waste which would be produced by mining-related activity, how these wastes would be monitored, and how they would be disposed of.

Response: The various descriptions concerning the handling of waste materials have been revised to include additional information. (See sections A.3, C.1, and C.7 of appendix A.) PPC would obtain all necessary permits for the construction and operation of waste sites required by the State of Wyoming.

5. Comment: The commenter (letter No. 8) was concerned that the ammonium nitrate-fuel oil mixture (ANFO) used to blast the consolidated overburden and coal at the proposed mine would pollute ground water and/or surface water through incomplete explosion or spillage.

Response: ANFO is essentially a combination of a nitrogen fertilizer and fuel oil that acts as an explosive when properly mixed and detonated. It is loaded into drill holes for detonation in the form of a damp powder. Any spillage is easily cleaned up and either recycled or disposed of, using standard procedures. While incomplete detonation may result in some of the fertilizer and fuel oil remaining in the rubble of the fractured overburden or coal, the small quantities involved and the inevitable dilution that occurs as the overburden or coal is moved from one location in the mine pit to another should limit any potential impact to the environment. These impacts were evaluated by OSMRE and determined to be negligible. For this reason, they were not analyzed further.

6. Comment: The commenter (letter No. 8) suggested that the EIS should include more detail on the types of structures that would be constructed around the fuel storage tanks, both above and below ground, to prevent and/or minimize soil, ground-water, and surface-water contamination, should one of the tanks leak or rupture.

Response: Specific information concerning the fuel storage tanks and the types of structures that would contain any spills is unavailable at this time. PPC has, however, committed to the preparation of a Spill Prevention Control and Countermeasure (SPCC) plan, to be approved by the appropriate regulatory authority prior to implementation. (The description concerning the fuel storage system has been revised to include this information. See section A.3 of appendix A.) With this commitment, any potential impacts to the environment from improper facility construction (i.e., tank leakage) should be limited. These impacts were evaluated by OSMRE and determined to be negligible. For this reason, they were not analyzed further.

7. Comment: The commenter (letter No. 8) requested more information on PPC's plans for the postmining reconstruction of Dry Fork Little Powder River.

Response: PPC has committed to the reconstruction of the major drainage channels within the proposed Dry Fork life-of-mine area. In accordance with Wyoming DEQ regulations (Chapter IV, Sections 2 and 3, Wyoming DEQ, Land Quality Division Rules and Regulations), PPC and other mine operators are required to meet minimum performance standards (i.e., controlling erosion, minimizing sediment production, and ensuring slope stability, etc.). Failure to adequately meet these standards during the 10-year liability period after the end of mining and reclamation activities could result in either the postponement of reclamation bond release or the forfeiture of the bonds. The postmining topography discussion has been revised to include additional information on the replacement of drainages. (See section D.2 of appendix A.)

8. Comment: Miscellaneous comments received by OSMRE also (a) provided additional information for OSMRE's consideration and/or provided minor text corrections (letter Nos. 9, 12, and 16), (b) expressed agreement woth OSMRE's conclusions contained in the EIS (letter Nos. 3, 4, 6, 7, 8, 11, 14, and 17), or expressed a preference for alternative 2 over alternative 1 (letter Nos. 4 and 11).

Response: OSMRE appreciates all comments and has considered each one carefully in the preparation of the final EIS. Appropriate text corrections have been made.

APPENDIX D

HYDROLOGIC ANALYSIS OF POTENTIAL DEPLETION OF MOYER SPRINGS

This appendix contains the main text of a report, prepared for OSMRE under contract by J. F. Sato and Associates and Koch and Associates, that quantifies the probable effect of mining on Moyer Springs. Specifically, the report details (1) the results of various runs made, assuming different variables, of a computer groundwater model the contractors developed to describe the combined effect of the proposed Dry Fork mine, the one proposed mine, and the six adjacent existing mines on flow from Moyer Springs and (2) the conclusions the contractors reached on the basis of these runs regarding the extent to which mining would deplete that flow. J. F. Sato and Associates and Koch and Associates developed their groundwater model and their assumptions regarding mining independent of PPC, which also modeled the probable consequences of mining to Moyer Springs (Phillips Petroleum Company, 1982-86). OSMRE's analyses of the site-specific and cumulative impacts of mining on the springs, presented in chapter IV, are based on data and conclusions contained in this appendix. The full text of the Sato/Koch report can be reviewed by the public at OSMRE, Western Field Operations, 1020 - 15th Street, Brooks Towers, Second Floor, Denver, Colorado.

HYDROLOGIC ANALYSIS OF POTENTIAL DEPLETION OF MOYER SPRINGS

Prepared for
OFFICE OF SURFACE MINING
Western Technical Center

by

J.F. SATO AND ASSOCIATES
and
KOCH AND ASSOCIATES

Under
Contract No. J5140143
Task Order No. 2

February, 1986

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I. Introduction

Moyer Springs is a series of naturally occurring springs along the lower reaches of Moyer Springs Creek, close to the northern boundary of proposed Dry Fork permit area, near Gillette, Wyoming (figures I-1 and I-2). The average flow of the springs as measured at a V-notch weir is 0.89 cubic feet per second (ft^3/sec). At the confluence with the Dry Fork Little Powder River, the total surface flow along Moyer Springs Creek is relatively constant at 1.27 ft^3/sec. The volume and steadiness of the spring discharge appear to support the conclusions that:

- The spring is in equilibrium with the aquifer system that feeds it.
- The aquifer system is of regional extent. It is believed that the scoria aquifer from which the springs issue is fed by the coal, and overburden aquifers as well as by direct precipitation.

Potential impact resulting from reduced discharge from Moyer Springs due to the proposed Dry Fork mine and the seven other active or proposed mines northeast of Gillette is one of the hydrologic issues that need to be addressed in the environmental impact statement (EIS) for the proposed Dry Fork mine. Hydrologic analyses of the area have been previously conducted as part of the various permitting processes, the latest being the digital computer analysis which is part of the Dry Fork mine permit application.

The object of the current ground water model was to quantify the impact of mining on the flow of Moyer Springs. Hydrogeologic studies described in the Dry Fork mine permit application indicated that Moyer Springs is a discharge point for the regional coal/scoria aquifer. There are eight active and proposed mines in the area northeast of Gillette that could conceivably impact the flow of Moyer Springs: Dry Fork (proposed), Fort Union, Buckskin, Rawhide, Eagle Butte, East Gillette (proposed), Clovis Point, and Wyodak. A two dimensional finite difference model was setup to simulate the impacts of these eight mines on the coal/scoria aquifer and Moyer Springs.

The model used for this project was a finite difference model of ground water flow developed by Donald Koch for the U.S. Office of Surface Mining, Reclamation, and Enforcement (OSMRE). This model is a modified version of the Prickett-Lonnquist finite difference model (Prickett and Lonnquist, 1971). This model can simulate artesian or water table

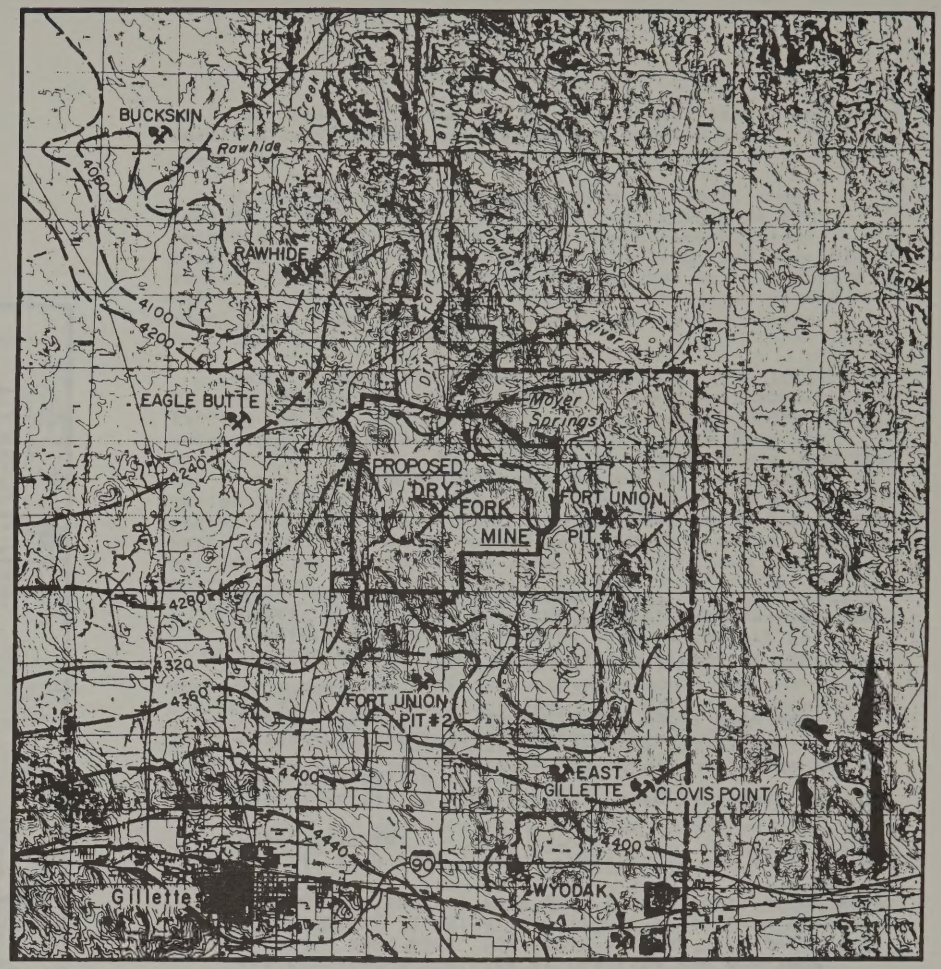


Figure I-1. Regional water level contours in the Gillette area, Wyoming. (Compiled from Phillips Petroleum Company, 1982-86; Frontier Coal Company, 1984-85; Gillette Area Groundwater Monitoring Organization, 1985.)

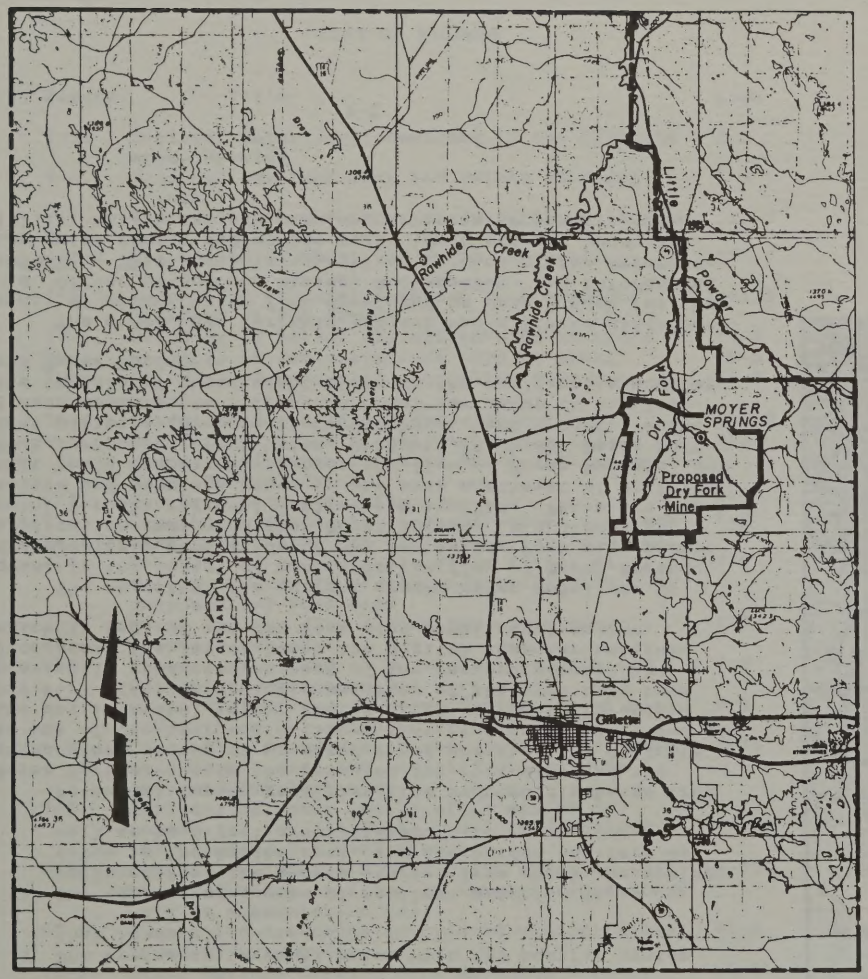


Figure I-2.__ Proposed Dry Fork Mine and extent of model boundary.

aquifers, irregular boundaries, variable pumping rates, underground mines, surface mines, and reclaimed mines. Both ground water inflows and drawdowns caused by mining can be calculated.

The current study differs from the modeling effort submitted with the Dry Fork mine permit application in the following respects:

- The model area is larger than in previous models, thus avoiding boundary effects. The model grid is 29 columns by 27 rows. It covers an area of 320.6 square miles.
- It takes into account Fort Union Pit No. 2 which was not proposed for mining at the time the previous analyses were made, but which now has been permitted. The Buckskin, Rawhide, and Wyodak mines were also not included in the Dry Fork mine permit application model.
- Smaller grid node spacing was used in the area around Moyer Springs.
- More sensitivity analyses have been performed in the current modeling effort.
- Different assumptions regarding the aquifer characteristics of the reclaimed spoil were made by the two models.
- The two models used significantly different routines to simulate mining. Wells were used in the Dry Fork permit application modeling effort, and constant head nodes were used in this study.

II. Data

Sources of data for the ground water model included the permit applications of the various mines and publications of the Gillette Area Ground-water Monitoring Organization (GAGMO).

The three geologic horizons discretized in the model were the coal seam, the scoria, and the no-coal horizon. There is considerable evidence that Moyer Springs is fed by regional flows from the coal and the scoria aquifers. Consequently, the coal and scoria beds were treated as one unit and the top and bottom elevations for the combined strata where input to the model. The elevations were derived from structure maps, isopach maps and cross-sections in the permit applications for most of the modeled area. For areas not covered by these sources, extrapolations were made based on dip and coal thickness reported in the relevant permit applications.

Dips are horizontal to very shallow to the west over most of the area. Half of a degree of dip was assumed to represent regional dip. Average coal bed thicknesses increase from south to north and range between 70 feet at the Wyodak mine to 120 feet at the Buckskin mine. West of the East Gillette, Fort Union Pit No. 2, Eagle Butte and Buckskin mines, average thicknesses of 85 feet, 90 feet, 112 feet and 120 feet were assumed, respectively.

Scoria beds are most extensive over the eastern third of the modeled area. Thicknesses are not always well defined or uniform. Borehole logs in the Rawhide and Dry Fork permit applications indicate a range of 40 to 60 feet in thickness. For areas east and south of the Fort Union Pit No. 1, scoria thicknesses were derived from cross-sections in the Fort Union permit application.

Two areas where coal is missing either due to non-deposition or erosion have been identified through sub-surface investigation around the Dry Fork mine. One no-coal area runs north-south near the western edge of permit boundary and the second area extends east-west across the northern portion of the permit area. Top and bottom elevations for the coal/scoria unit were extended through the no-coal channels with the assumption that whatever lithology is occupying this horizon will also be saturated but will have aquifer characteristics different from the coal/scoria aquifer.

The coal/scoria aquifer is of regional extent and under confined conditions over most of the modeled area. It is under unconfined conditions along the outcrop.

Hydrologic parameters considered for model input include initial water level elevations, the value of recharge and discharge (including evapotranspiration), hydraulic conductivity, storage coefficient, and specific yield. The coal/scoria aquifer is assumed to be infinite in all directions except along the eastern boundary of the model area where a no-flow boundary exists due to the outcropping of the coal/scoria.

Water surface elevations for the study area (figure I-2) were derived from three sources: the permit applications for the Dry Fork and Fort Union mines, and the GAGMO 1985 annual report. Data in these references were from the period 1982 to 1984. The Dry Fork mine source was used for the central portion of the modeled area in the vicinity of the proposed Dry Fork mine. For the eastern and southern parts, elevations were taken from the Fort Union mine permit application. The GAGMO report provided data mainly for the northwest part of the study area. Contour lines were extrapolated for areas west of the permit boundaries of Eagle Butte and Fort Union Pit No. 2, the extreme northern and southern edges, and the northwest corner.

Recharge and discharge values were based on the analyses presented in the ground water model included in the Dry Fork mine permit application. In addition, the alluvial valley floor chapters in the permit applications for Buckskin, Rawhide, and Eagle Butte mines were used to identify areas of subirrigation and obtain estimates of discharge where available.

The aquifer characteristics of the coal/scoria aquifer were obtained from collecting the pump-test data contained in the permit applications of the eight mines in the study area. The data are shown in appendix A. The data were averaged by type of aquifer, and by mine area. Geometric means and standard deviations were computed for hydraulic conductivity. Hydraulic conductivity is typically assumed to come from a lognormal distribution (Freeze and Cherry, 1979), therefore the geometric mean presents a truer measure of central tendency than the arithmetic mean. Tables II-1 and II-2 show the results of these calculations. In table II-1, the number of pump tests, geometric means and standard deviations of hydraulic conductivity are cross tabulated by mine and by aquifer. In table II-2, the number of pump tests where a storage coefficient was determined, and the

Table II-1. Statistical and cross tabulation analysis of pump-test data

Number of pump tests by mine and aquifer

		BS	DF	EB	EG	FU1	FU2	RH	WY	ALL
a	coal	13	17	2	14	8	9	13	1	77
q	no coal	0	2	0	0	0	5	2	0	9
u	scoria	0	4	0	0	6	0	6	0	16
i	scoria/coal	0	5	0	0	0	0	0	0	5
f	other	0	2	1	0	0	0	4	3	10
e	all	13	30	3	14	14	14	25	4	117
r										

Geometric mean hydraulic conductivity by mine and aquifer (gal/day/ft²)

		BS	DF	EB	EG	FU1	FU2	RH	WY	ALL
a	coal	12.28	16.91	0.36	13.22	1.26	5.10	5.94	0.99	7.43
q	no coal		3.15				0.13	0.89		0.25
u	scoria		11016			143315		312.1		7576
i	scoria/coal		124.9							124.9
f	other		93.27	12.65				294.3	2.16	39.07
e	all	12.28	56.07	1.02	13.22	184.9	1.39	20.51	1.75	19.16
r										

Key to mine codes

BS - Buckskin
DF - Dry Fork
EB - Eagle Butte
EG - East Gillette and Clovis Point
FU1 - Fort Union Pit No. 1
FU2 - Fort Union Pit No. 2
RH - Rawhide
WY - Wyodak

Table II-1. Statistical and cross tabulation analysis of pump-test data - continued

Standard deviation of hydraulic conductivity by mine and aquifer (gal/day/ft²)

		BS	DF	EB	EG	FU1	FU2	RH	WY	ALL
a	coal	21.9562	51.2812	0.6	47.6642	7.08240	19.3470	11.2882	0	36.6020
q	no coal		0.15				0.32185	0.08		1.23306
u	scoria		215150			1330026		12619.9		908135
i	scoria/coal		101.756							101.756
f	other		6.5	0				3804.22	9.86120	2651.59
e	all	21.9562	89687.7	5.65455	47.6642	967001	16.4885	7408.74	9.11907	357167
r										

Geometric standard deviation of hydraulic conductivity by mine and aquifer (gal/day/ft²)

		BS	DF	EB	EG	FU1	FU2	RH	WY	ALL
a	coal	5.74	4.61	3.61	3.74	3.84	3.57	3.12	0	5.47
q	no coal		1.05				4.06	2.24		5.84
u	scoria		9.09			18.10		58.47		66.86
i	scoria/coal		3.86							3.86
f	other		1.07					7.83	7.27	14.91
e	all	5.75	15.43	7.22	3.74	468.7	8.92	29.50	5.79	33.77
r										

Key to mine codes

BS - Buckskin
DF - Dry Fork
EB - Eagle Butte
EG - East Gillette and Clovis Point
FU1 - Fort Union Pit No. 1
FU2 - Fort Union Pit No. 2
RH - Rawhide
WY - Wyodak

Table II-2. Statistical and cross tabulation analysis of storage coefficient data

Number of pump tests where the storage coefficient was determined by mine and aquifer

		BS	DF	EB	EG	FU1	FU2	RH	ALL
a	coal	9	2	0	11	0	5	0	27
q	no coal	0	0	0	0	0	2	0	2
u	scoria	0	0	0	0	3	0	1	4
i	scoria/coal	0	1	0	0	0	0	0	1
f	other	0	0	1	0	0	0	2	3
e	all	9	3	1	11	3	7	3	37
r									

Average storage coefficient by mine and aquifer

		BS	DF	EB	EG	FU1	FU2	RH	ALL
a	coal	0.00137	0.009		0.00232		0.00048		0.00216
q	no coal						0.00009		0.00009
u	scoria					0.33		0.352	0.3355
i	scoria/coal		0.007						0.007
f	other			0.002				0.2001	0.13407
e	all	0.00137	0.00833	0.002	0.00232	0.33	0.00037	0.25073	0.04891
r									

Standard deviation of storage coefficient by mine and aquifer

		BS	DF	EB	EG	FU1	FU2	RH	ALL
a	coal	0.00108	0.001		0.00215		0.00027		0.00256
q	no coal						0.00001		0.00001
u	scoria					0.16573		0	0.14384
i	scoria/coal		0						0
f	other			0				0.1999	0.18804
e	all	0.00108	0.00125	0	0.00215	0.16573	0.00029	0.17823	0.12786
r									

Key to mine codes

BS - Buckskin
DF - Dry Fork
EB - Eagle Butte
EG - East Gillette and Clovis Point
FU1 - Fort Union Pit No. 1
FU2 - Fort Union Pit No. 2
RH - Rawhide
WY - Wyodak

average and standard deviation of storage coefficient are shown. The no-coal aquifer category includes pump tests of the no-coal channels occur within the coal seam. The "other" aquifer category includes pump tests of the coal aquifer where it was in contact with some other aquifer such as the alluvium or only the upper or lower split of the coal seam was tested. The geometric standard deviation was computed as the antilog of the standard deviation of the logarithmically transformed hydraulic-conductivity data. This calculation has little statistical significance except that it provides a measure of the statistical dispersion around the geometric mean. The data in table II-1 shows no discernible trends in hydraulic conductivity except for the obvious variation between aquifers. The lack of trend may be due to the intrinsic variability of the coal aquifer or it may be due to the variation in pump-test procedures. The pump test data includes slug test data, single-well tests, recovery tests, and multiwell tests. The pump tests were of varying durations, and different analytical methods were used. For some pump tests, no thickness was reported, so a coal thickness of 100 feet was assumed. A subjective inspection of the data indicates that the variations between mines are due as much to varying procedures as to actual differences in hydraulic conductivity.

The data in table II-2 show the differences between the locations of the different aquifers. The coal and scoria/coal aquifers are typically under both confined and unconfined conditions so the average storage parameter derived from analysis of pump test data is indicative of intermediate conditions between artesian and water table. The scoria is almost always under water table conditions and has a very large specific yield. The category, "other", includes some pump tests of the scoria which bias the average storage coefficient to a large number which is indicative of the specific yield of the scoria. The no-coal channels are always under artesian conditions, hence, the small storage coefficient.

III. Description of the Model

The model used for this project is a modified version of the Prickett-Lonnquist finite difference model. This model can simulate artesian or water table aquifers, irregular boundaries, variable pumping rates, underground mines, surface mines, and reclaimed mines. Both groundwater inflows and drawdowns caused by mining can be calculated. The algorithm used in this model is the modified alternating direction implicit method as explained in Illinois Water Survey Bulletin 55 (Prickett and Lonnquist, 1971).

A full explanation of the theory of the Prickett-Lonnquist model is given in Prickett and Lonnquist (1971) and by OSMRE (Office of Surface Mining, 1981). Briefly, the two-dimensional partial differential equation of groundwater flow is discretized into finite difference form. A set of simultaneous linear equations are derived at each time step. The modified alternating direction implicit method is used to solve the equations. The algorithm then advances to the next time step and the process is repeated. The solution method is unconditionally stable (for linear equations, i.e. a confined aquifer).

A number of modifications have been made to the basic model. These modifications include routines for modeling variable pumping rates, induced infiltration, storage coefficient conversion, water table conditions, and variable grid sizes. These modifications are fully described in Prickett and Lonnquist (1971) and Office of Surface Mining (1981).

Additional modifications were made to the Prickett-Lonnquist model to permit the simulation of mining. These additional modifications constitute the OSMRE version of the model. The model contains routines to simulate underground mines, partial penetration mines, full penetration mines, and reclaimed mines. The details of the full penetration mine and reclaimed mine algorithms will be presented here since they are the ones that were used at the Dry Fork Mine.

A mine that goes completely through an aquifer and intercepts all flow within a model node is a full penetration mine. The basic Prickett-Lonnquist model does not contain any provisions for simulating this type of ground water sink (mine or excavation). The Prickett-Lonnquist model was designed to simulate constant-discharge sinks, such as wells, not variable-discharge, constant-head sinks, which most accurately describe mines. The OSMRE

version of the Prickett-Lonnquist model was created to permit the accurate simulation of constant-head sinks (mines).

A full-penetration mine can cause problems with the solution algorithm. Full-penetration mines create a discontinuity in the transmissivity matrix. The discontinuity occurs because the bottom of the mine may be below the bottom of the aquifer. Thus, no flow can occur in this node, and the transmissivity matrix contains a zero element. The algorithm used to solve the matrix may not be able to solve a matrix with a discontinuity.

This problem may be overcome by simulating a fully penetrating mine as a constant-head node with the head set at the elevation of the bottom of the mine or bottom of the aquifer, whichever is higher. Water is allowed to freely flow into the node as it would into a mine and yet no discontinuity is created because flow continues in the node. The full penetration mine is characterized in the model by the elevation of the bottom of the mine and the length and width of the pit. Flow into the mine is computed with the following algorithm:

$$Q=(2a/(2DELX-b))\ T\ (H_{i+1,j} + H_{i-1,j} - 2X)$$

$$+\ (2b/(2DELY-a))\ T\ (H_{i,j+1} + H_{i,j-1} -2X)$$

where

- Q=inflow (gal/day)
- T=transmissivity (gal/day/ft)
- a=width of mine in y direction (ft)
- b=length of mine in x direction (ft)
- $H_{i,j}$=head elevation in node i,j (ft)
- X=elevation of bottom of pit (ft)
- DELX=width of node in x direction (ft)
- DELY=width of node in y direction (ft)

Transmissivity is calculated as the arithmetic average of the effective transmissivity in the mine node and the adjacent node:

$$T_{i,j,1}= 0.5\ K\ ((H_{i,j+1} - BOT_{i,j+1}) +(H_{i,j} - X))$$

where

- $T_{i,j,1}$=transmissivity from node i,j to node i,j+1 (gal/day/ft)
- K=hydraulic conductivity (gal/day/ft^2)
- $BOT_{i,j}$=elevation of bottom of aquifer at node i,j (ft)

The original OSMRE model permitted the entry of only one

mine size parameter, thus assuming a=b. Additional modifications were made to the input routines of the model to permit entry of both length and width parameters.

The algorithm for simulating full penetration mines also entails some additional assumptions. The water stored in the node is not accounted for when the change over from aquifer node to mine node occurs. If the mine pit is much smaller than the original node, this error may become significant. The error will only manifest itself in the computations of mine inflow and not in the distribution of drawdown. The other assumption implicit in the full penetration mine algorithm is that the mine is always located at the center of the node. The model can correctly simulate the inflow and drawdown when only a portion of the node is mined by using the algorithm described above. The model does not distinguish, for example, between mining the southwest corner of the node and the northeast corner. Figure III-1 is a generic illustration of how the model approximates a mine pit.

Reclaimed areas may be simulated with the model. The model assumes reclaimed land will be an unconfined aquifer. The spoil material may have a different hydraulic conductivity and specific yield than the undisturbed aquifer. The spoil is assumed to be relatively homogeneous with no confining layers.

There were several additional modifications made to the model for this project. These modifications did not affect the basic mathematical algorithm of the model but were added to assist in the operation of the model. A subroutine was added to the model that permits a new input data set to be prepared with the last computed value of head as the initial heads for the next computer run. Another subroutine was added to the model to output the data to a separate file in a form suitable for input to a plotting algorithm. The dimensions of some of the variables have been changed from their values in the OSMRE version of the program. This was done because of the large number of nodes that were mined. A change was made in the format of entering the aquifer characteristics of backfilled mine spoil. The original OSMRE model requires that the user compute the appropriate storage factors and hydraulic conductivities for the reclaimed mine nodes; the new version performs these computations internally. Another minor but valuable change to the model was the addition of a variable time step capability. Time steps may either be constant or increased geometrically. The ability to increase the time step geometrically is useful for simulating steady state

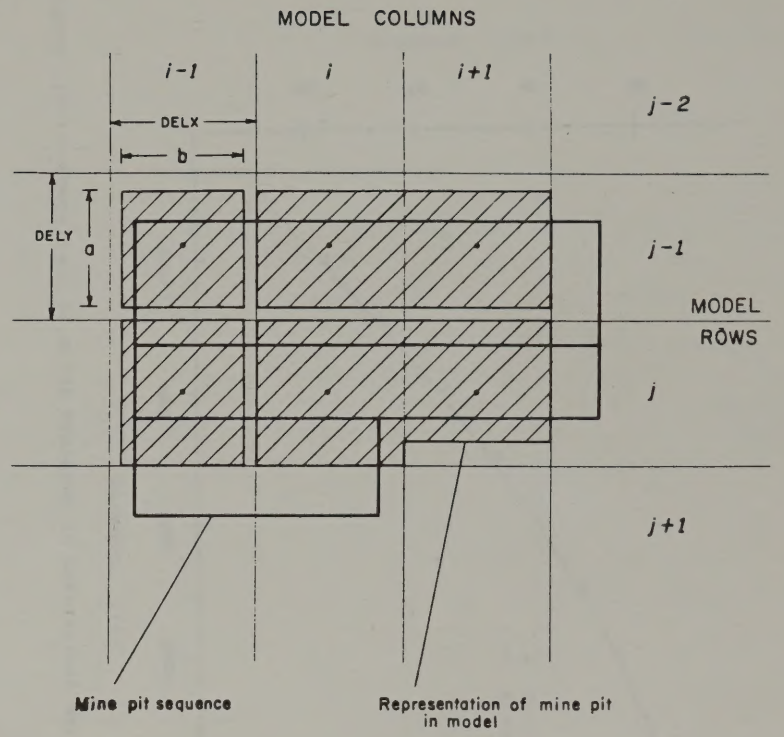


Figure III-1.---Representation of mine pit infinite difference model

conditions and simulating the potentiometric surface recovery at a reclaimed mine. Both of these situations call for the simulation of very long periods of time. Another subroutine was added to the model to permit outputting of stream or spring depletion. This subroutine outputs the change in discharge from the three grid nodes that represent Moyer Springs Creek. The discharge changes are output to separate file at the end of each time step. This data may then be plotted and analyzed. A complete listing of the model used in this study is shown in appendix B.

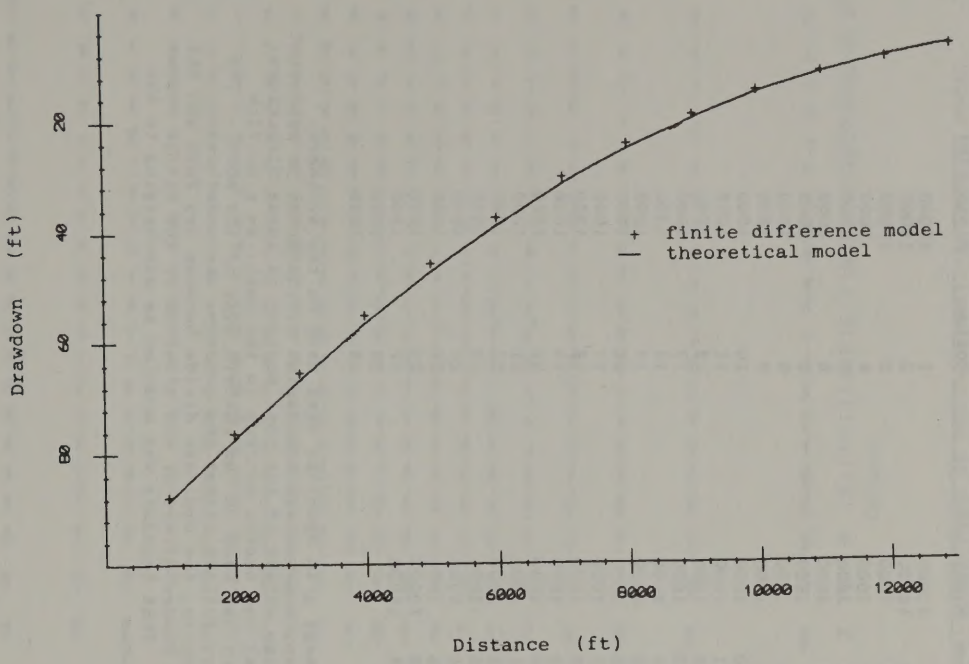
Model output includes the input data, and the time, total error, number of iterations, and inflows to each mine node at each time step. At user selected time steps, drawdown in every grid node is printed. At the end of the simulation, the model computes a node by node water balance as an extra check on the accuracy of the solution. A sample of the model output is shown in appendix C. The first output shows the control parameters, mine pit inflows for each time step, and the computed drawdowns at every eighth time step. The second output shows the mine pit location and timing input data. The third output shows the grid node input data. These three outputs are normally on the same output file, but were put on different files for this project.

Whenever significant changes are made to a numerical model, it is desirable to test the model against some known solution. The model used for this project was tested against the analytical solution for the drawdown caused by an infinite length line sink in a confined aquifer. Flow to the line is one dimensional. This analytical equation is:

$$s(x,t)=s_w \operatorname{erfc}(x(S/Tt)\cdot^5)$$

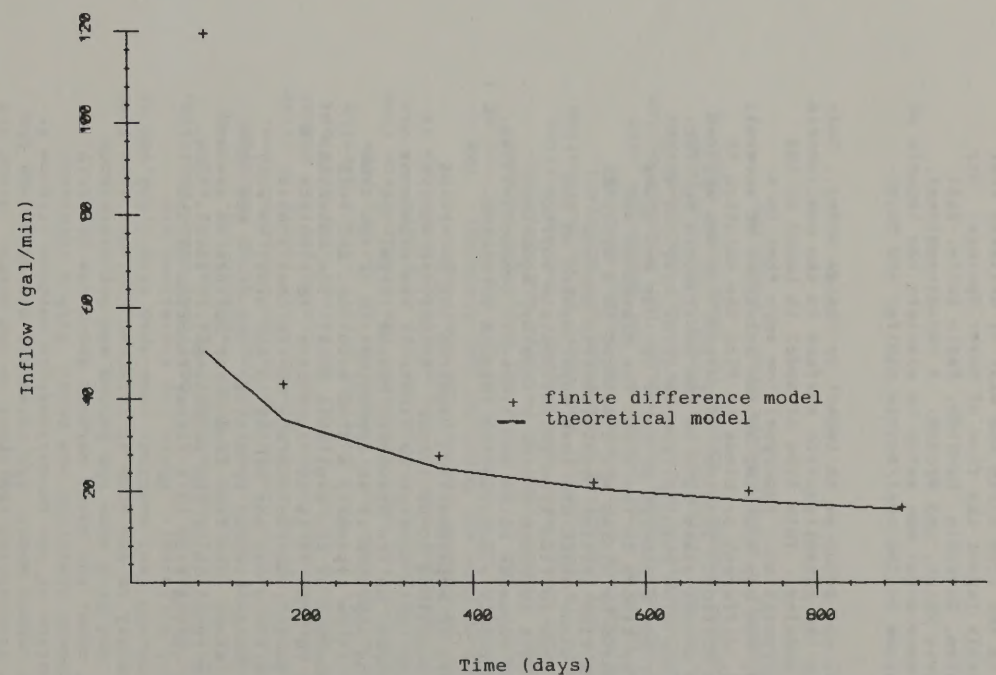
where
- $s(x,t)$=drawdown at time, t and distance, x (ft)
- s_w=drawdown of infinite length line sink (ft)
- x=distance perpendicular to line sink (ft)
- t=time (days)
- S=storage coefficient
- T=transmissivity (ft^2/day)
- erfc=complementary error function

A 21 by 21 node network was input to the model with a theoretical mine along row one (J=1). This layout approximates one dimensional flow in an aquifer. Grid dimensions were 1000 by 1000 feet in the middle of the mine area (row 1, columns 5-15). An infinite aquifer was simulated in the row and column directions by having node dimensions increase. Hydraulic conductivity was 20 gal/day/ft^2 and storage was 0.01. The mine was assumed to lower the water table 100 feet. Figures III-2 and III-3 compare the finite difference model output with the analytical solution. Figure III-2 compares pit inflow versus time for the two solutions. Figure III-3 compares drawdowns away from the pit. On Figures III-2 and III-3, the solid line represents the theoretical solution, and the plus marks represent the finite difference model solution. The comparison between the model and the analytical solution is good. As expected, the finite difference model approximation improves with increasing time and distance.



III-8

Figure III-3.--Comparison of model drawdown to theoretical drawdown at 900 days.



III-7

Figure III-2.--Comparison of model inflow to theoretical inflow.

IV. Model Setup

The objective of this study was to quantify the impact of mining on the flow of Moyer Springs. Hydrogeologic studies described in the Dry Fork mine permit application indicate that Moyer Springs is a discharge point for the regional coal/scoria aquifer. There are eight proposed and active mines in the area north and east of Gillette that could conceivably impact the flow of Moyer Springs: Dry Fork, Fort Union, Buckskin, Rawhide, Eagle Butte, East Gillette, Clovis Point, and Wyodak. A two-dimensional, finite difference model was setup to simulate the impacts of these eight mines on the coal/scoria aquifer and Moyer Springs.

The model was setup as an impact or change model. Only the changes in the potentiometric surface in the coal/scoria aquifer were modeled. This type of model is based on the theory of superposition. Superposition says that in a linear system, one may superimpose the solutions of several, easily solved, different problems to find the solution to another, more difficult problem. Superposition was applied by assuming a steady-state flow in the coal/scoria aquifer. The steady-state flow results from recharge over the extent of the aquifer and discharge at Moyer Springs and along alluvial valley floors in the area. The drawdowns and depletions caused by mining are simulated in a mythical aquifer with a flat initial potentiometric surface (elevation of zero) which are then superimposed on the steady-state flow to find true potentiometric surface elevations. This approach avoids a lengthy, nonunique calibration of recharge rates and hydraulic conductivities, and instead directly simulates the impacts of mining.

The theory of superposition requires the governing differential equations to be linear. A confined aquifer is linear; a water table aquifer is linear if the drawdowns are small. Of course, as the drawdowns become large, the impact-modeling approach is an approximation of the true solution, but it is typically a good solution, and well within the accuracy of the available data. The advantage of this approach is that it is not necessary to simulate the steady-state potentiometric surface of the coal/scoria aquifer before there was any mining in the area; we only simulate the changes caused by mining. Drawdowns are thus directly simulated. The flow from Moyer Springs is assumed to be a linear function of the potentiometric level, thus, the change in spring flow is a linear function of the drawdown.

The model grid was 29 columns by 27 rows. A variable size grid was used with the area around Moyer Springs and the Dry Fork mine being simulated with square grids that were one thousand feet on a side. The grid covered the area between 355,000 to 443,500 feet easting and 1,297,000 to 1,398,000 feet northing (Wyoming State Plane coordinates). The model included a 320.6 square mile area. Row and column spacings are:

Row	Width (ft)	Column	Width (ft)
1	15000	1	20000
2	10000	2	15000
3	7000	3	10000
4	5000	4	7000
5	3000	5	5000
6	2000	6	3000
7	1500	7	2000
8	1500	8	1500
9	1000	9	1500
10	1000	10	1000
11	1000	11	1000
12	1000	12	1000
13	1000	13	1000
14	1000	14	1000
15	1000	15	1000
16	1000	16	1000
17	1000	17	1000
18	1000	18	1000
19	1000	19	1000
20	1500	20	1000
21	1500	21	1000
22	2000	22	1000
23	3000	23	1000
24	5000	24	1000
25	7000	25	1000
26	10000	26	1000
27	15000	27	1500
		28	2000
		29	3000

Very large grid spacings were used on the southern, northern, and western boundaries of the model to represent the large extent of the coal aquifer in these directions. The coal and scoria outcrop to the east, so a no-flow boundary was used on the eastern edge of the model. The boundary follows either the outcrop, the unsaturated coal/scoria, the drainage divide between Dry Fork and the Little Powder River, or the alluvium of the Little Powder River. That boundary was modeled as discharging to the alluvium.

The tops and bottom elevations of the coal scoria aquifer were discretized and input to the model. Since the model was an impact model, the reference elevation was the initial elevation of the potentiometric surface (figure I-1). The reference elevation was zero. With a reference elevation of zero, the model outputs drawdowns directly. Figures IV-1 and IV-2 show the bottom and top elevations used in the model in the area of interest (columns span from 410,000 to 440,000 feet easting, rows span from 1,330,000 to 1,360,000 feet northing). Where top elevations are negative, the aquifer is initially confined, where positive, the aquifer is initially unconfined. The positive top elevations have no influence on model calculations.
In order to use the impact-model approach, it is necessary to know the steady-state discharges in the simulated area. Discharges include spring flow, ground water runoff to river valleys, and evapotranspiration. Many discharges are almost impossible to measure in the field, therefore they must be determined indirectly. This modeling effort relied heavily on the finite difference model presented in the Dry Fork mine permit application that simulated the steady-state flow in the coal/scoria aquifer around the Dry Fork mine (appendix D-6, addendum D-6E of the permit application). This model was calibrated against the observed potentiometric surface and Moyer Springs discharge. The calibration resulted in a reasonable, but nonunique, set of input parameters. The calibration was nonunique because there were other combinations of recharge and hydraulic conductivity that could have been chosen. The combination chosen, however, is reasonable, and there is no information indicating that the resulting parameters are incorrect. This previous modeling effort made the impact-modeling approach used in this study possible. The discharges were simulated in the model using the induced infiltration option of the Prickett-Lonnquist model. The actual discharge is considered to be the difference, a steady-state discharge less the depletion caused by mining (or some other impact).

actual discharge = steady-state flow - depletion

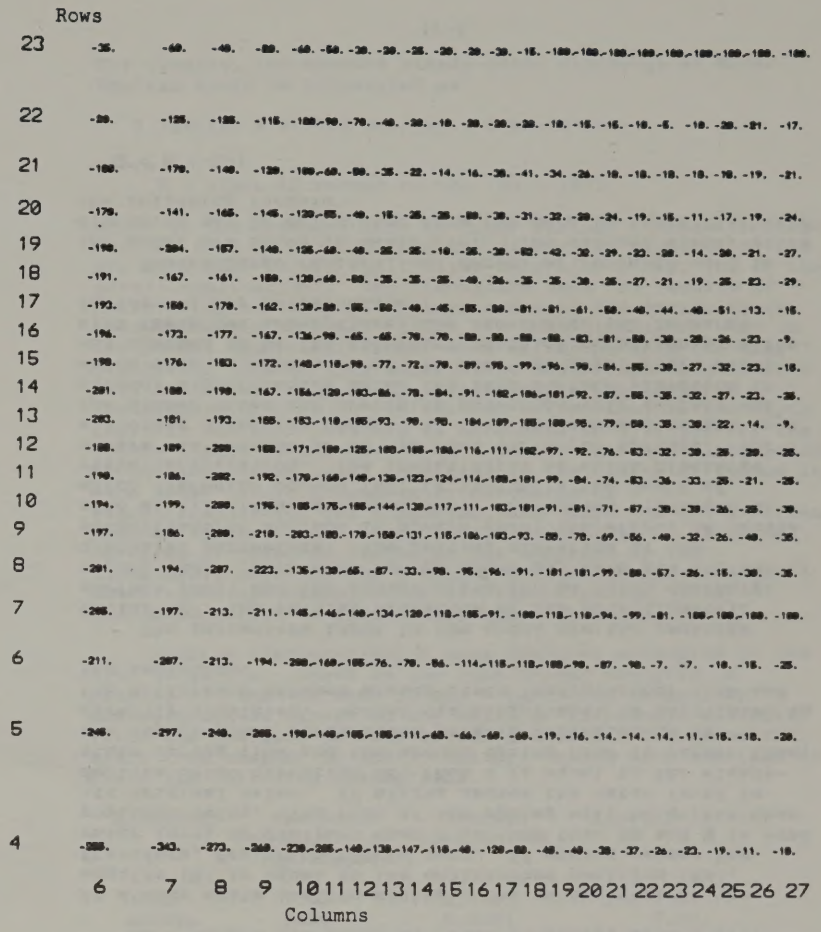


Figure IV-1.--Gridding of bottom elevations used in model. (Values are in feet from potentiometric surface.)

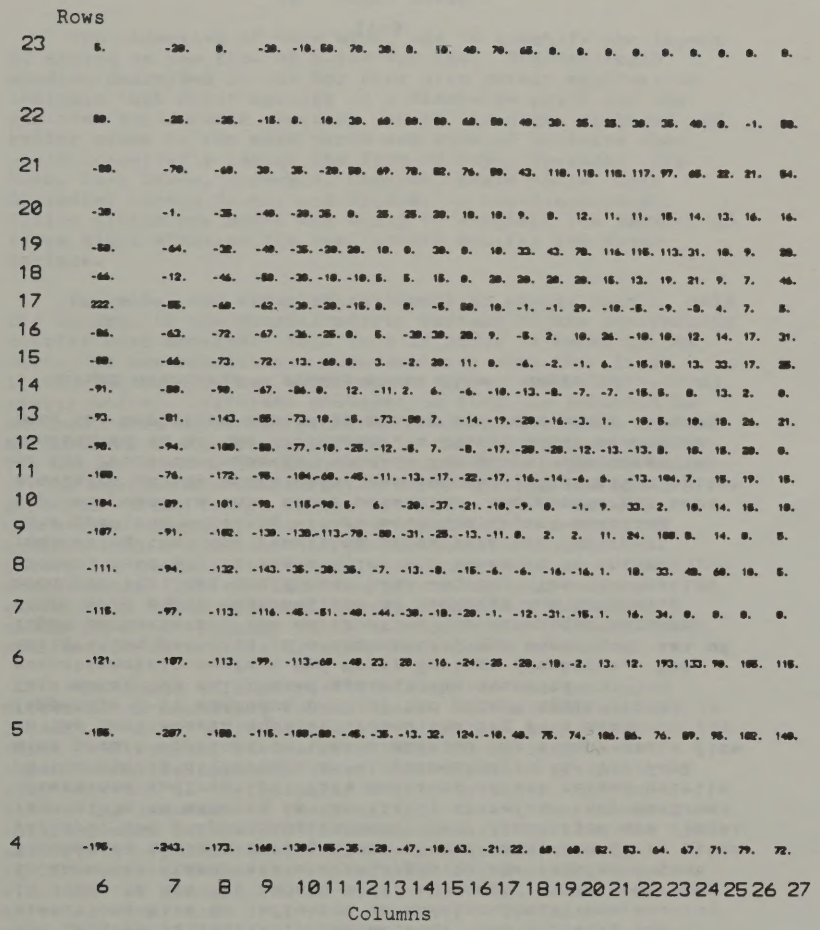


Figure IV-2.--Gridding of top elevations used in model. (Values are in feet from potentiometric surface.)

The finite difference model only simulates the depletion term with the following equation.

$$Q = R\,(RH-H) \quad \text{when } H > RD$$
$$Q = R\,(RH-RD) \quad \text{when } H \leq RD$$

where
Q = depletion (gal/day)
R = recharge factor (gal/day/ft)
RH = initial elevation of potentiometric surface (ft)
H = potentiometric elevation (ft)
RD = lowest elevation at which discharge occurs (ft)

At steady state (before mining), the water level in the aquifer (H) is equal to its undisturbed position (RH), therefore, depletion (Q) is zero. If mining causes the water level to decline, then H is less than RH and Q is some positive value. The flow of the spring will be Q less than its original value. If mining causes the water level to decline below elevation RD, then Q is equal to the steady-state spring flow and the actual spring flow is zero. Thus, the impact-model formulation permits depletion to be directly simulated. Actual discharges must be calculated as the difference between steady-state (undisturbed) flow and the depletion.

The parameters input to the model are the recharge factor (R), the initial elevation of the potentiometric surface (RH), and the lowest elevation at which discharge occurs (RD). Each node in the model may have its own set of discharge parameters. The initial elevation of the potentiometric surface is always zero; therefore, RH equals zero at all discharge locations. The lowest elevation at which discharge occurs (RD) is typically the depth of evapotranspiration. The lowest depth at which discharge occurs was assumed to be -25 feet for Moyer Springs. For all other discharge nodes, -20 feet was assumed except in a few places where the premining potentiometric surface was already significantly below the land surface elevation in which case an elevation of -10 feet was used. This depth was assumed to be the effective depth of evapotranspiration. With these two assumptions, and knowing Q, the recharge factor (R) may be calculated.

The recharge factors, and depths of recharge used in the model are shown in table IV-1. The assumed steady-state discharge may be calculated from the data in table IV-1 with the following formula

$$Q = R\,(-RD)$$

Table IV-1. Discharge parameters used in model
(E = 10 raised to the power of)

Column	Row	Name	Length(ft)	R(gal/day/ft)	RD(ft)
17	18	Moyer Springs	-	2.3E4	-25
16	19	Moyer Springs Cr	1000	4.9E3	-20
15	20	Moyer Springs Cr	1500	7.4E3	-20
13	19	Dry Fork	800	170	-20
14	19	Dry Fork	1000	213	-20
14	20	Dry Fork	2000	426	-20
13	18	Dry Fork	1200	256	-20
13	17	Dry Fork	1500	320	-20
12	16	Dry Fork	1500	320	-20
12	15	Dry Fork	1200	256	-20
11	14	Dry Fork	1000	213	-20
11	13	Dry Fork	1000	213	-20
14	21	Dry Fork	2000	1.9E4	-20
14	22	Dry Fork	2500	2.3E4	-20
14	23	Dry Fork	3000	2.8E4	-20
14	24	Dry Fork	7000	6.6E4	-20
14	25	Dry Fork	3000	2.8E4	-20
15	25	Little Powder	6000	5.6E4	-20
13	26	Little Powder	7000	6.6E4	-20
12	26	Little Powder	5000	4.7E4	-20
10	27	Little Powder	-	5.8E4	-20
9	27	Little Powder	-	5.8E4	-20
8	26	Rawhide Cr	4000	3.8E4	-20
7	26	Rawhide Cr	4000	3.8E4	-20
6	25	Rawhide Cr	2000	1.9E4	-10
5	26	Rawhide Cr	5000	4.7E4	-20
4	26	Rawhide Cr	7000	6.6E4	-20
5	25	Rawhide Cr	15000	1.4E5	-10
5	23	Rawhide Cr	5000	4.7E4	-20
24	3	Ditto Lake	-	6.7E3	-20
25	18	Garner Lake	-	3.8E3	-20
25	19	Garner Lake	-	3.8E3	-10

For example, the assumed steady-state discharge at Moyer Springs would be calculated as

$$2.3E4(25) = 5.75E5 \text{ gal/day} = 0.89 \text{ ft}^3/\text{sec}$$

where
E = times 10 raised to the (E4 = 10^4)

which is the measured flow of Moyer Springs. These recharge factors were calculated from the discharges reported in the Dry Fork mine permit application (appendix D-6,p. 165 of the permit application). The discharges were the results of calibrating a finite difference model to the steady-state potentiometric surface. Since the node dimensions used in the permit application model were different than the node dimensions used in this model, some additional calculations were necessary. The total stream length was measured on a topographic map. With the assumed evapotranspiration depth (RD), it was then possible to calculate an R factor for the entire length of stream. This R factor was then distributed along each stream reach according to the length of stream in each node. Where ground-water discharge by evapotranspiration was suspected, and there was not a stream channel (Garner Lake, Ditto Lake, large areas of alluvium), the area of probable discharge was measured on the topographic maps and the R factor calculated based on the potential evapotranspiration (45 inches/year). This procedure seemed to yield reasonable estimates.

Aquifer characteristics were assigned according to the type of strata. Based on the statistical analysis in chapter II, and the lack of any clear trend in aquifer characteristics except on the basis of lithology, a single value was assigned to each lithologic unit. The geometric means from chapter II and literature values were combined to yield the following assumptions.

Lithology	Hydraulic conductivity (gal/day/ft²)	Storage coefficient	Specific yield
coal	7.60	0.0001	0.07
scoria	2400	0.0001	0.30
no coal	.25	0.0001	0.1

Figures IV-3 and IV-4 show the distribution of specific yield and hydraulic conductivity used in the central section of the model.

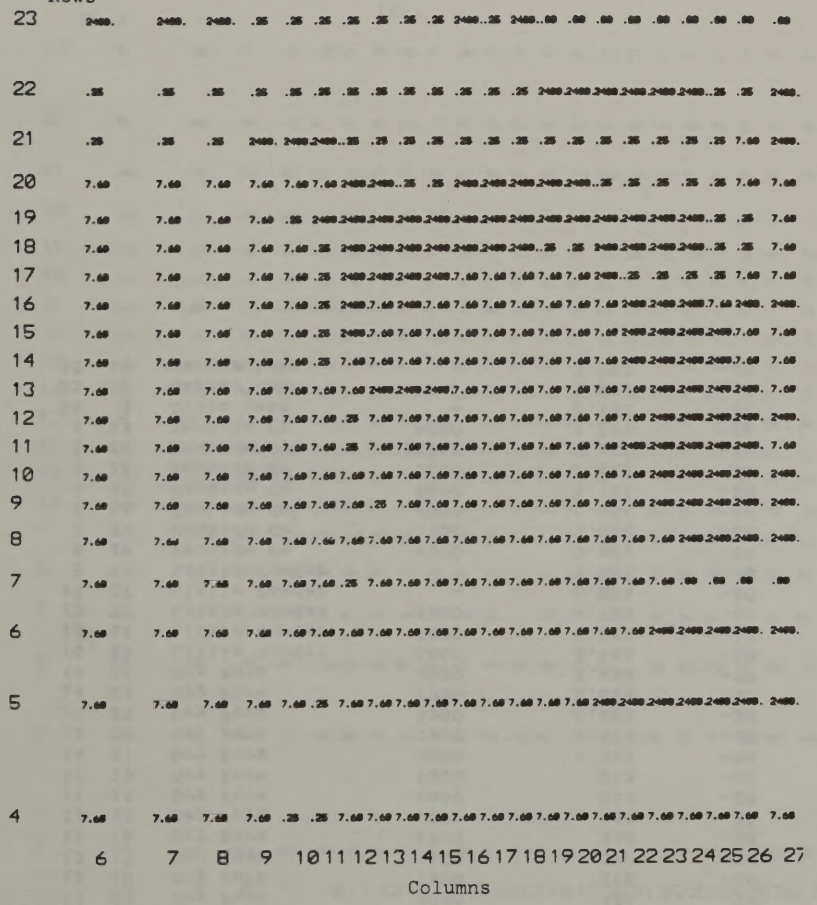


Figure IV-3.--Gridding of hydraulic conductivity used in model (gal/day/ft^2).

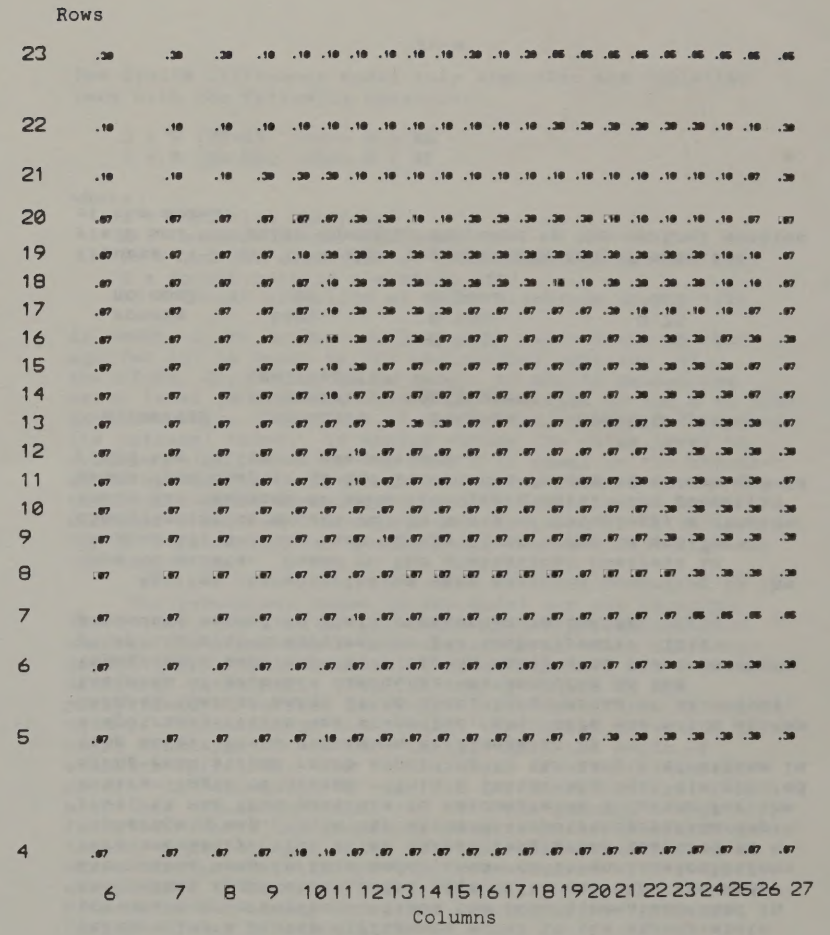


Figure IV-4.--Gridding of specific yield used in model.

Mining was simulated using the algorithm described in chapter III. It was necessary to input the length and width of each mine in each node for each time step. Mining was discretized at 2-year intervals; each mine pit had a single location for each 2-year period. This discretization scheme required some arbitrary decisions about where to place the mine pit during each two year period, since the actual area mined in two years would typically cover more than a single grid node of the model. The mine pit lengths and widths were assumed to be 1,000 by 1,000 feet unless there was evidence in the mine plans of a different size. At the end of each 2-year period, the entire area that the real mine would cover in that two years is reclaimed. The model simulates reclamation by setting the potentiometric surface at the bottom of the aquifer, raising the top of the aquifer so that the spoils are always unconfined, and assigning values for the spoil hydraulic conductivity and specific yield. Spoil hydraulic conductivity was assumed to be 1.0 gal/day/ft^2 and spoil specific yield was assumed to be 0.1. These values are based on the experience of the authors with other surface coal mines in the Powder River Basin.

The typical model run was 144 time steps of 90 days each. This approximately 36-year time period was designed to include the active mining plans in the area. Some arbitrary decisions were made regarding the timing of mining. The simulation was assumed to begin in 1984 and continue until 2020. Mining before 1984 was assumed to have negligible impact on Moyer Springs. The impact of mining before 1984 on the potentiometric surface was implicitly included in the simulation by using the 1982-84 potentiometric surface as the starting point of the simulation. The assumption was made that this initial potentiometric surface was at steady state. This assumption is obviously not true, because lowering of the potentiometric surface has already occurred around the Wyodak and Rawhide mines. The assumption of steady state is believed to not impact the simulated impacts of the flow of Moyer Springs, however, and in the absence of extensive premining water level data, no other assumption was possible.

At the end of the 36-year active mining simulation, the model saved the resulting drawdowns in a format that made restarting the model possible. All mine pits were removed from the model and the recovery of the potentiometric surface after mining was simulated. These recovery runs were made with variable length time steps so that long periods of time could be economically simulated. Typically, 36 time steps with an initial time step of 100 days, and a time step multiplier factor of 1.2 were used. This

combination of parameters permitted over 200 years of recovery to be simulated.

V. Results

The model was run to simulate conditions that will occur over a period of approximately 36 years. This period covered the extent of all currently planned mining in the area as evidenced by the mine plans currently on file with OSMRE. Appendix C shows a sample of the output from the model.

Depletions from Moyer Springs and Moyer Springs Creek were recorded on a disk file and then transformed so the spring flow versus time could be plotted. Figure V-1 shows spring flow versus time for Moyer Springs and Moyer Springs Creek. The largest predicted reduction in the flow of Moyer Springs is 0.22 ft^3/sec, which is 25 percent of the original flow. The largest predicted reduction in the flow of Moyer Springs Creek is 0.27 ft^3/sec, which is 22 percent of the original flow. These impacts occur after about 16 years of mining at Dry Fork when the mine pit is relatively close to the springs. The fluctuations in predicted spring flow, as shown on figures V-1 and V-2, are a function of the position of the mine pit in the model. When the Dry Fork mine pit is far from Moyer Springs, impacts are small. When the mine pit is close to the Springs, impacts are large. The Dry Fork mine pit begins in the northwest section of the permit area, not far from Moyer Springs. Two pits will exist as mining proceeds both north and south. Depletion is relatively large at this stage of the mine operation. The northern pit is then reclaimed and the southern pit is at the southern end of the permit area. Impacts on Spring flow are relatively small at this time. The mine pit then moves to the north and east. After approximately 16 years of mining, the mine pit will be at its closest point to Moyer Springs and the spring flow will be affected the most. Mining at Dry Fork ends in the 22 year of the simulation. Spring flow recovers slowly after mining is completed.

Figure V-2 shows the predicted inflow to the Dry Fork Mine pits over time. The inflow peaks occur whenever the mine pit moves (at 2-year intervals in the model). In reality, pit inflow will be fairly continuous, since the mine pit moves continuously. Inflow is larger when the mine pit is close to the scoria and smaller when it is far from the scoria.

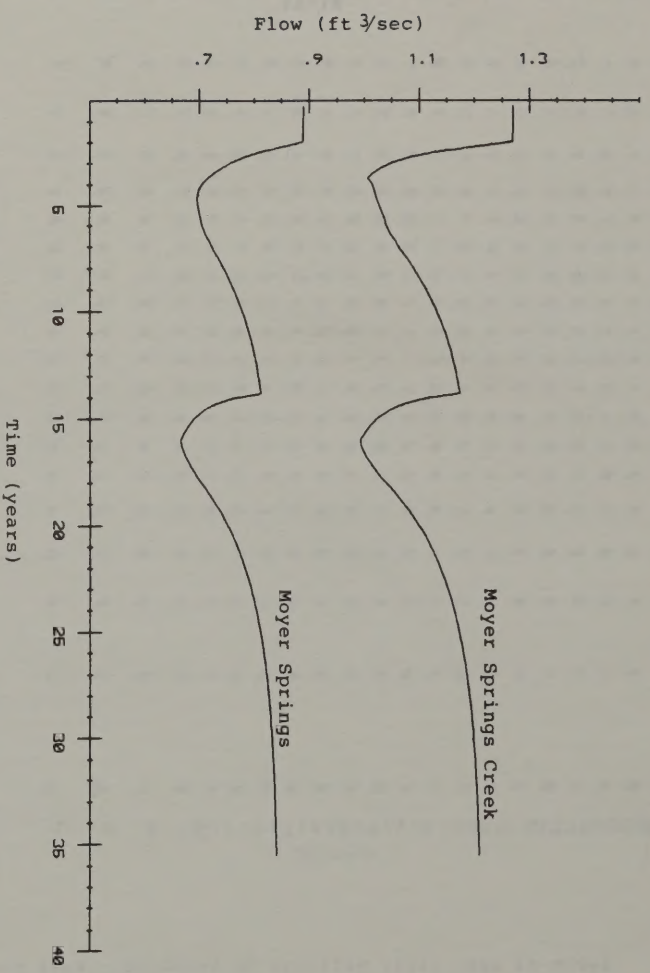


Figure V-1.--Cumulative impacts of the eight existing or proposed mines on flows of Moyer Springs and Moyer Springs Creek.

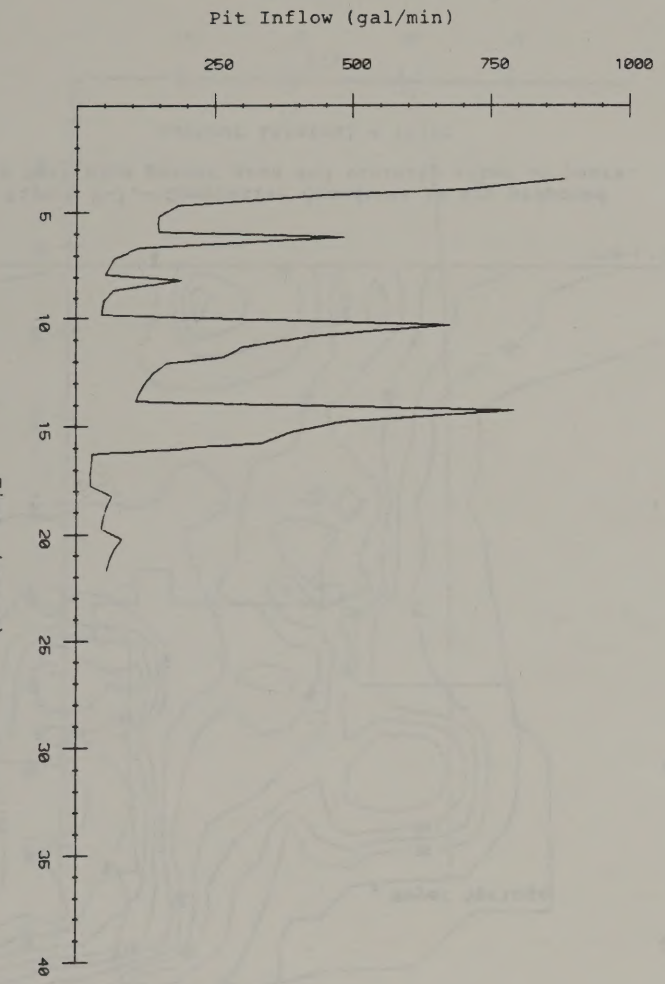


Figure V-2.--Dry Fork mine-pit Inflow.

Figure V-3 shows the drawdowns around the Dry Fork mine at the end of the simulation. The lower left corner of the figure V-3 plot is at State Plane coordinates 410,000 easting, and 1,330,000 northing. The plot is at a scale of 4285.7 feet per inch. The potentiometric surface in the coal aquifer is extensively drawn down by the cumulative impact of mining. It is not possible to define the extent of the 5-foot drawdown contour with this model; drawdowns are larger than 5 feet throughout the modeled area except in the scoria aquifer at the eastern edge of the modeled area.

The recovery of water levels after the completion of mining was simulated by restarting the model without any active mines. Six hundred years of recovery were simulated using a variable-length time step. Figure V-4 shows the recovery of the potentiometric surface at column 18, row 14. This point is inside the Dry Fork mine permit area, approximately 4100 feet southeast of Moyer Springs. This point is representative of the coal aquifer within the Dry Fork mine permit area. The majority of the recovery occurs within 200 years, although there is still some residual drawdown 600 years after all mining has been completed. The flow of Moyer Springs will still be impacted by mining throughout this recovery. Figure V-5 shows the flow of Moyer Springs for the first 200 years of the recovery period. Recovery of spring flow is at first rapid (see figure V-1), and then very slow and gradual; after 200 years of recovery, there is still a spring depletion of 1.5 percent.

Another simulation was done to see what the impacts on spring flow would be without the Dry Fork mine. The impact of the seven remaining mines (Buckskin, Rawhide, Eagle Butte, Fort Union Pits No. 1 and No. 2, Wyodak, East Gillette and Clovis Point) was simulated. All other parameters were the same. Figures V-6 and V-7 show the predicted flows for Moyer Springs and Moyer Springs Creek without the Dry Fork mine compared to flows with the Dry Fork mine. Notice that flow declines throughout the active mining simulation. The lowest predicted spring flow occurs 42 years after all mining has been completed. The largest predicted reduction in the flow of Moyer Springs caused by the cumulative impact of the seven mines is 0.04 ft^3/sec, a depletion of 4.5 percent. Figure V-8 shows the predicted drawdowns. Notice that drawdowns are still extensive, but much smaller in the Moyer Springs area. Figure V-9 shows the recovery of the potentiometric surface at column 18, row 14 after 36 years of mining . Notice that drawdowns continue to increase after the termination of mining as ground water flows into the reclaimed spoils from the

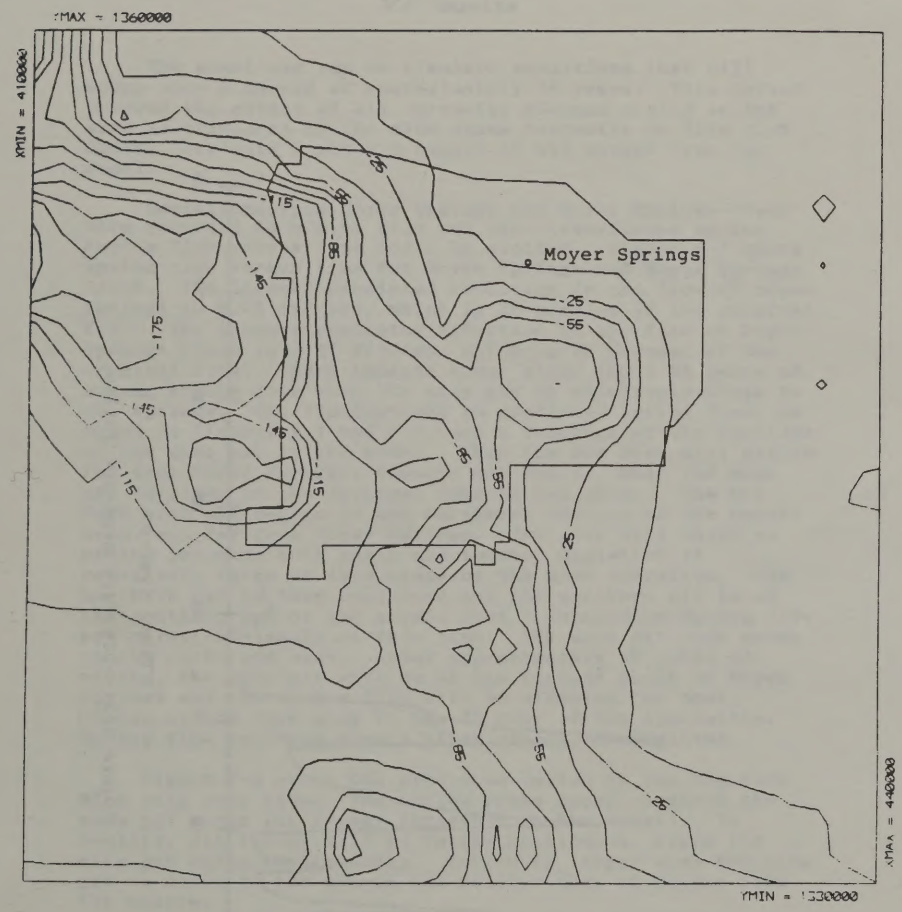


Figure V-3.--Cumulative drawdowns in the proposed Dry Fork mine permit area and vicinity after 36 years.

contour interval = 15 ft

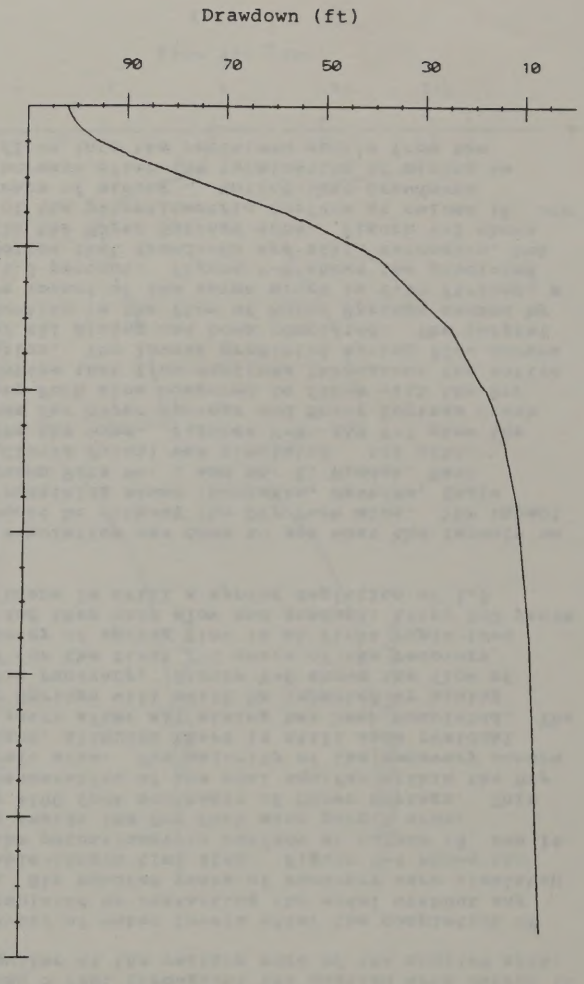


Figure V-4.--Recovery of water levels after mining at column 18, row 14, of model grid with the proposed Dry Fork mine.

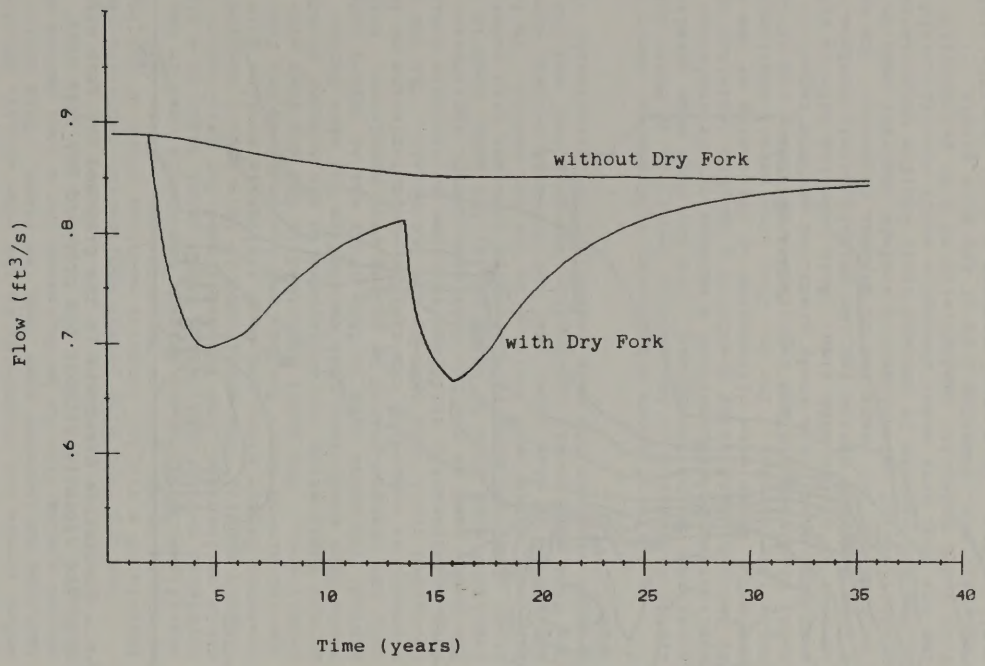


Figure V-6.--Impacts of mining to Moyer Springs with and without the proposed Dry Fork mine.

V-8

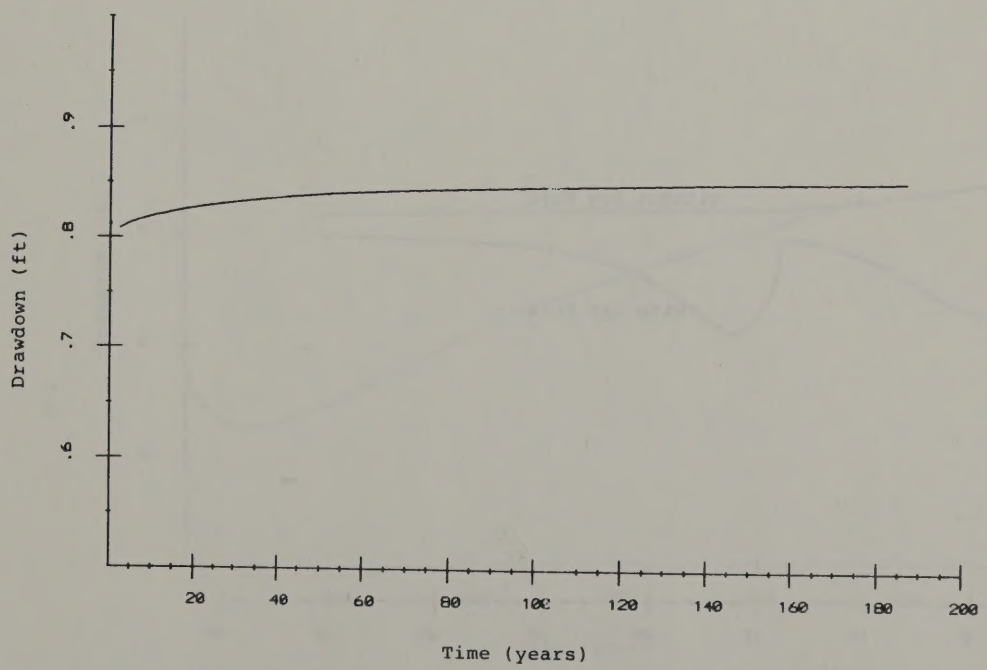


Figure V-5.--Moyer Springs flow during postmining recovery period.

V-7

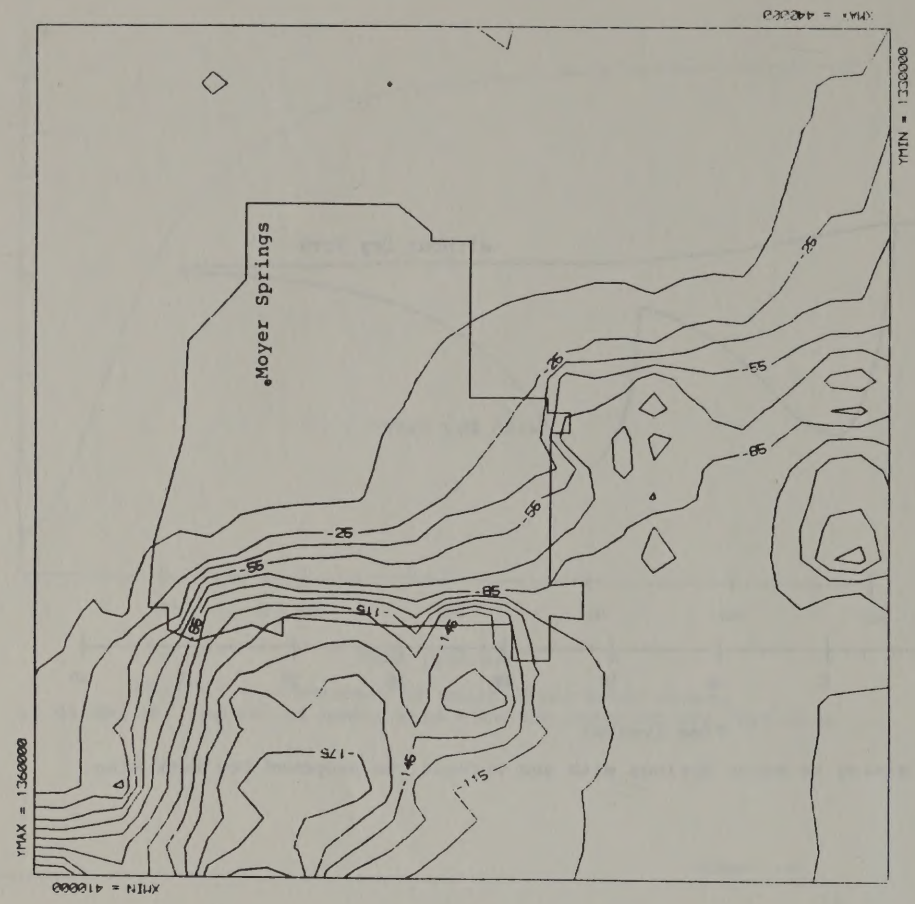


Figure V-8.--Cumulative drawdowns in the proposed Dry Fork mine permit area and vicinity without the proposed Dry Fork mine.

V-10

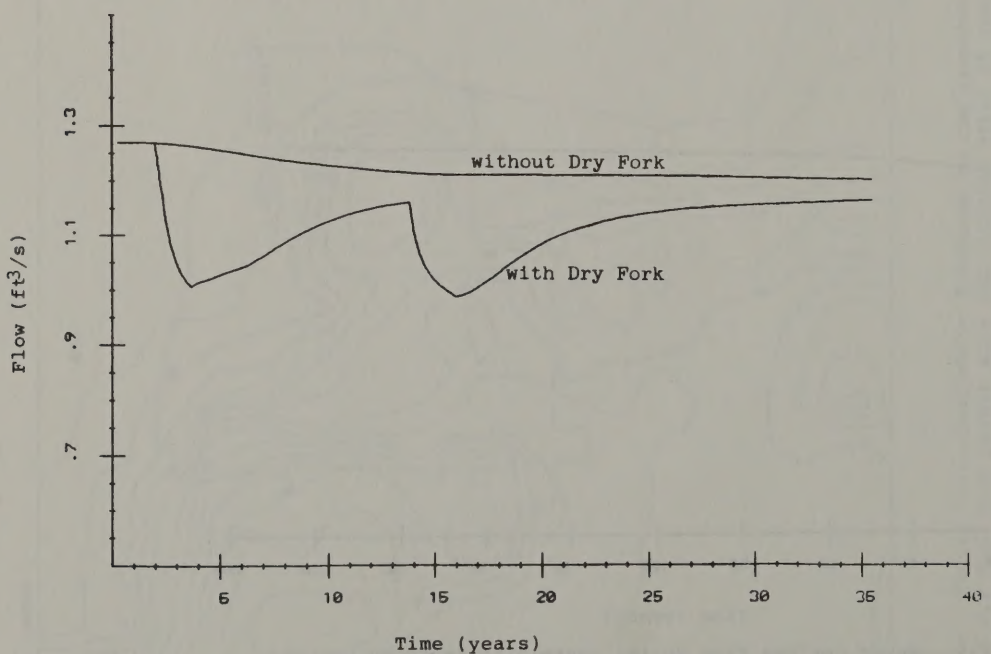


Figure V-7.--Impacts of mining to Moyer Springs Creek with and without the proposed Dry Fork mine.

V-9

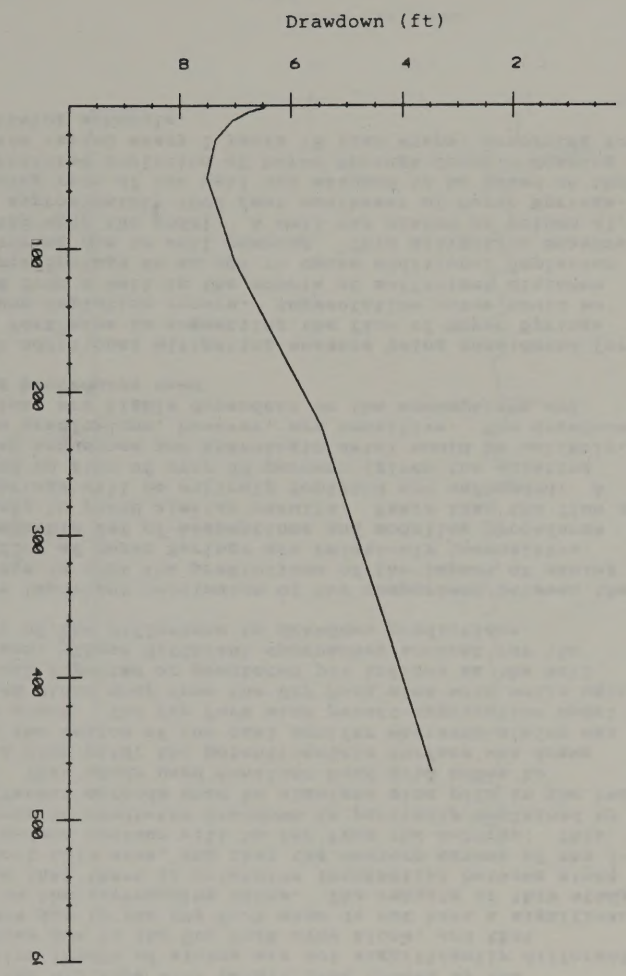


Figure V-9 .--Recovery of water levels after mining at column 18, row 14, of model grid without the proposed Dry Fork mine.

surrounding areas during the recovery period. So while water levels are recovering in the mine spoils, drawdowns continue to increase away from the mines. This effect also causes spring flow to be depressed for a long period after mining.

The Dry Fork mine permit application contained the results of a similar computer modeling study of the impact of mining on the flow of Moyer Springs. There were significant differences between the models used in the Dry Fork mine permit application (head model based on a steady-state calibration) and the model used for this report (impact model). The model used in this report covered a somewhat larger area, and used a slightly smaller grid spacing around Moyer Springs and the proposed Dry Fork mine permit area. The model described in the Dry Fork mine permit application was calibrated to the assumed steady state flow conditions that existed in the area before mining; the model used in this study was an impact model; only the changes caused by mining were simulated. Different assumptions regarding the aquifer characteristics of the reclaimed spoil were made by the two models. The two models used significantly different routines to simulate mining. The model used in the Dry Fork mine permit application simulated mine pits by using wells; the model used in this study simulated mine pits by using constant head nodes. Different mines were included in the two models. In fact, the change in mine plans that has occurred between when the Dry Fork mine permit application was prepared, and the present time was the main reason for the preparation of this report.

In spite of these significant differences, there was little difference in the maximum depletion of Moyer Springs predicted by the two models. The Dry Fork mine permit-application model predicted a maximum spring depletion of 29 percent; this study predicted a maximum depletion of 25 percent. There were differences in the timing of the spring depletion, however. The Dry Fork mine permit-application model predicted maximum impact to come at the end of the 20 year mine plan; this study predicted maximum impact to occur in year 16 of the mine plan. Both modeling efforts predict a long recovery period for the potentiometric surface, on the order of 200 years for 90 percent recovery. The similar predictions of potentiometric surface recovery came in spite of the differences in assumed spoil aquifer characteristics. The Dry Fork mine model assumed a spoil specific yield of 0.20 and a hydraulic conductivity of 6.36 gal/day/ft^2 (appendix D-6, addendum D-6E of the mine permit application). This study assumed a spoil specific yield of 0.1 and a hydraulic conductivity of 1.0 gal/day/ft^2. The

hydraulic diffusivity (transmissivity / specific yield) of these assumptions is different by a factor of 3.

The most significant difference between the two models was the predicted drawdowns due to the cumulative impact of all mining in the area. The Dry Fork mine plan (vol 17., p. 160 of the permit application) states that drawdowns within the Dry Fork mine permit area caused by the cumulative impact of mining are not significantly different from those due to the Dry Fork mine alone, and that drawdowns due to the Dry Fork mine do not have a significant effect on the surrounding mines. The results of this study indicate that there is extensive interaction between mines throughout this area, and that the western extent of the 5-foot drawdown contour will be far from the outcrop. This difference in predicted drawdown is partially explained by the different methods used to simulate mine pits in the two models. This study used constant head grid nodes to simulate mine pits; the potentiometric surface was drawn down to the bottom of the coal aquifer wherever mining was to take place. The Dry Fork mine permit-application model simulated mines away from the Dry Fork mine with wells using the actual reported or predicted pit inflows as the well discharges. These different approaches account for the majority of the difference in drawdown predictions.

One important conclusion of the comparison between the two models is that the predictions of the impact of mining on the flow of Moyer Springs are relatively insensitive. Any reasonable set of assumptions and modeling procedures are likely to yield similar results. Fears that the flow of Moyer Springs will be entirely depleted are unfounded. A reduction in flow of over 30 percent (given the existing mine plan sequences and hydrologic data) would be unlikely. Drawdown predictions, however, are sensitive. The drawdown predictions are highly dependent on the assumptions and modeling procedures used.

One additional mitigating measure being considered for the Dry Fork mine is augmenting the flow of Moyer Springs Creek when depletion occurs. Augmentation water could be supplied from a well in the scoria at sufficient distance from Moyer Springs so as not to cause additional depletion of the spring due to well pumping. This mitigation measure was tested with the model. A well was placed at column 21, row 17, approximately 4000 feet southeast of Moyer Springs. The pumping rate of the well was assumed to be based on the total predicted depletion of Moyer Springs Creek. Pumping rates were varied every 2 years (8 time steps) according to the following schedule.

Time step	Discharge (gal/min)
1	0.068
9	98
17	109
25	94
33	72
41	56
49	46
57	106
65	119
73	92
81	69
89	54
97	44
105	37
113	33
121	29
129	27
137	26

Figure V-10 shows the augmented flow of Moyer Springs Creek. This figure was constructed by running the model and finding the resulting depletion along Moyer Springs Creek and then adding back the above well pumpage. The jagged nature of the curve is due to the discretization of the well discharge at 2-year intervals. Notice that augmentation is not complete; there is some impact on the spring by the well. The maximum spring depletion from this mitigation scheme is about five percent, similar to the situation that is predicted to occur if the Dry Fork Mine is not constructed. An augmentation well in the scoria at least 4000 feet away from Moyer Springs is feasible based on the assumptions made in this study.

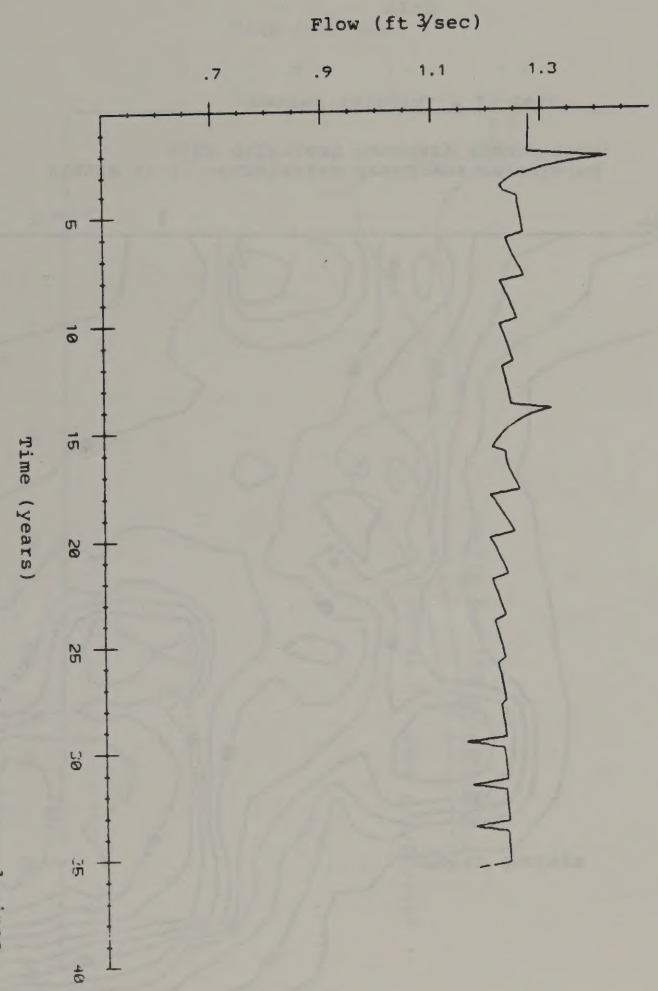


Figure V-10.--Cumulative impacts of the eight existing or proposed mines on flows of Moyer Springs Creek with an augmentation well.

VI. Sensitivity Analysis

Sensitivity analysis is an important part of any modeling study. There is almost always uncertainty about the correct values of many of the input parameters. Sensitivity analysis tests the response of the model to different values of the input parameters.

Sensitivity analysis was simplified because the model used in this study was an impact model, i.e. only the changes in head and discharge were simulated, rather than simulating steady state flows before mining. Changes in some parameters in a nonimpact model (hydraulic conductivity for example) require recalibration before changes may be simulated. An impact model permits any parameter to be changed and its sensitivity tested without additional calibration. Actually sensitivity analysis with an impact model involves changing the baseline assumptions which is analogous to a recalibration.

The sensitivity of the boundary assumptions to the west, north, and south was examined. The coal aquifer is effectively infinite in extent in these directions, but no-flow boundaries were used in the model. Sizable drawdowns occurred at the boundaries of the model. The impact of this arbitrary no-flow boundary assumption on the predicted flow of Moyer Springs was tested. All boundary nodes on the west, north, and south limits of the model had their storage coefficients increased to 1.0, which effectively converted these boundaries to no-flow boundaries. With this change, there were no differences in the predicted depletions, and no difference in the recovery of the potentiometric surface at column 18, row 14. Predicted drawdowns were less around the edges of the model. Figure VI-1 shows drawdowns in the same area as figure V-3. Drawdowns are about 10 feet less with a constant head boundary. The true-situation (no boundary) drawdown would be somewhere between the no-flow assumption and the constant-head assumption.

There is uncertainty regarding the correct aquifer characteristics for the scoria aquifer. The hydraulic conductivities and specific yields derived from pump test analysis are extremely large (see chapter II), however, there is reason to believe that the scoria aquifer is not continuous, but rather a series of high permeability zones separated by low permeability material. This belief is based on the fact that there is considerable hydraulic gradient throughout the scoria aquifer (see the Fort Union

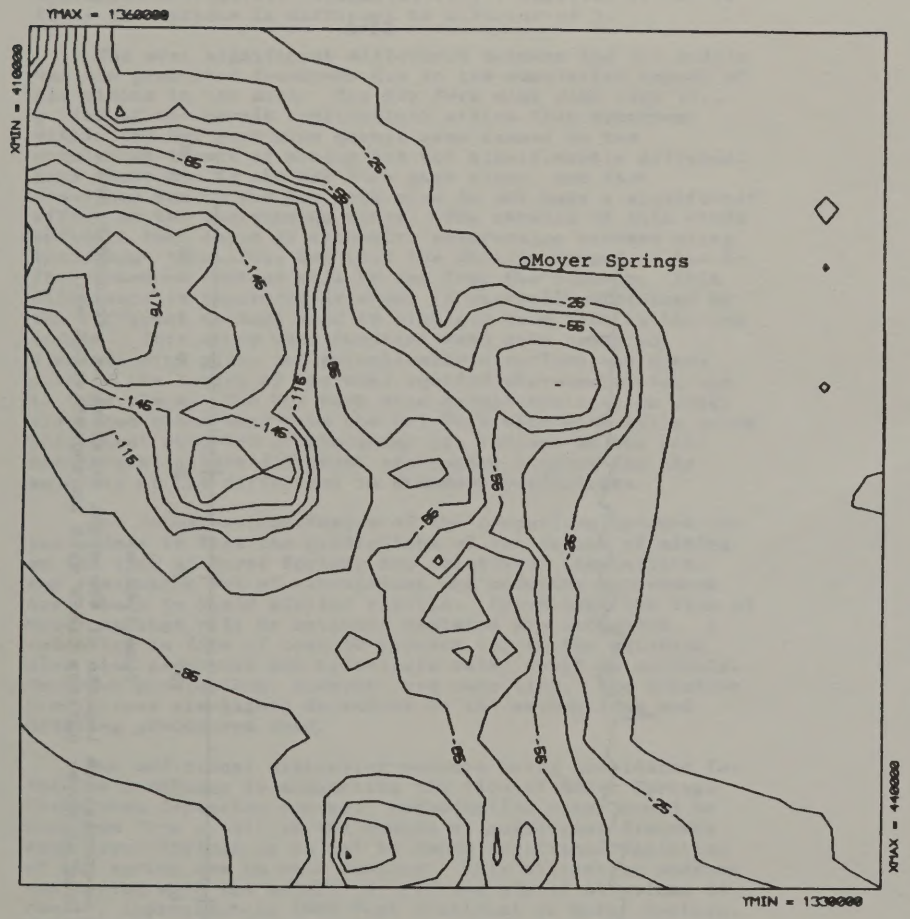


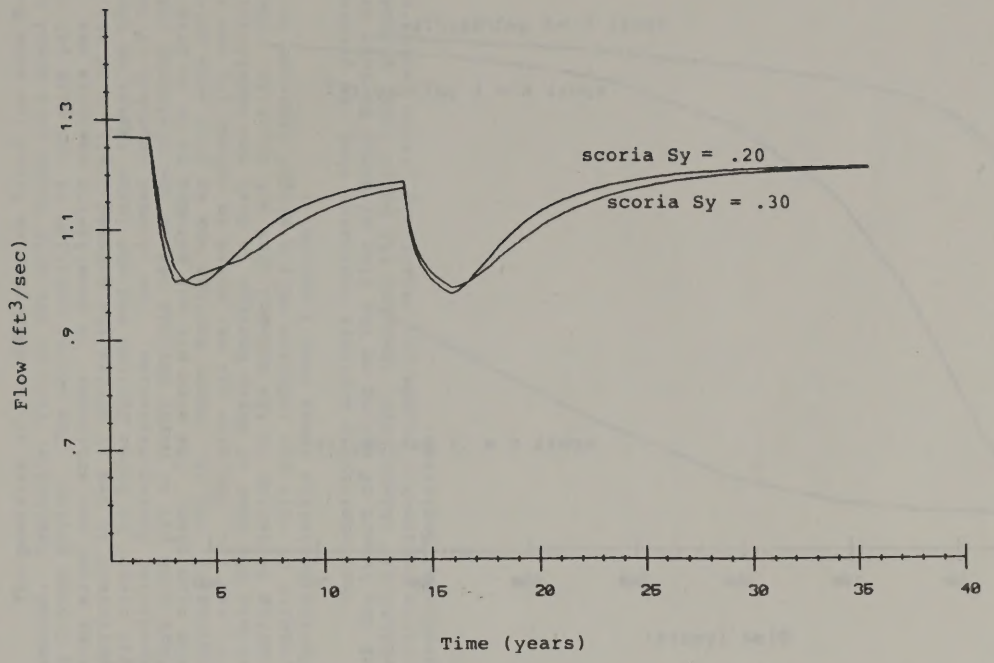
Figure VI-1.--Cumulative drawdowns calculated with different boundary assumptions.

Contour interval = 15 feet

mine permit application). If the effective transmissivity of the scoria aquifer was as large as pump testing indicates, the potentiometric surface would be flat throughout the scoria (or incredibly large quantities of ground water would be moving through it). Thus, the impact of a smaller scoria hydraulic conductivity on the flow of Moyer Springs was tested. The scoria hydraulic conductivity was reduced by a factor of 5 to 480 gal/day/ft². The results of this testing are shown in figure VI-2. Impacts on spring flow are smaller with a smaller scoria hydraulic conductivity. The minimum spring flow under this assumption is 0.81 ft³/sec, a depletion of 9 percent. A larger scoria hydraulic conductivity was not tested. It is extremely unlikely that the effective hydraulic conductivity of large areas of scoria is much larger than 2400 gal/day/ft².

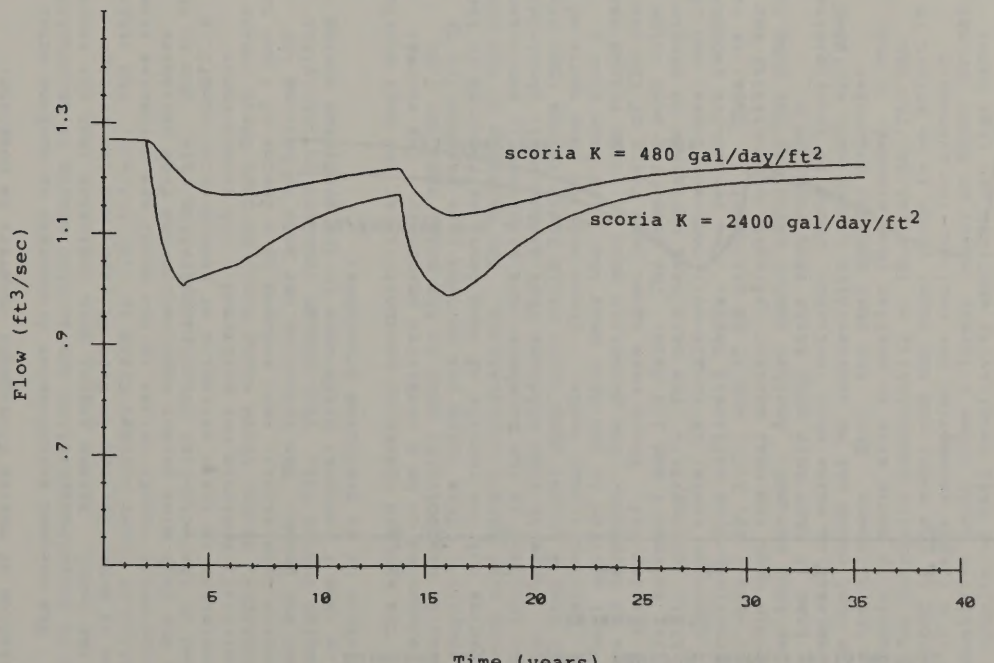
The sensitivity of the scoria specific yield was also tested. The value used in the model was 0.30. The arithmetic average specific yield for the scoria is 0.34 based on four pump tests. This is a very large value for any aquifer. A value of 0.20 was substituted in the model input and the model rerun. The resulting impacts on the predicted flow of Moyer Springs Creek are shown in figure VI-3. The minimum predicted flow from Moyer Springs is 0.66 ft³/sec, a reduction of 26 percent. The result of assuming a scoria specific yield larger than 0.30 was not tested as this would be an unrealistic situation.

The sensitivity of the hydraulic conductivity assumed for reclaimed spoils was tested. The initial assumption was 1.0 gal/day/ft². Values five times higher and lower than this were used in the model (0.2 and 5.0 gal/day/ft²). These changes had a small impact on the predicted flow of Moyer Springs. When spoil hydraulic conductivity was 5.0 gal/day/ft², the maximum spring depletion was 27 percent. When the spoil hydraulic conductivity was 0.2 gal/day/ft², the maximum spring depletion was 25 percent, essentially unchanged from the result obtained assuming a spoil hydraulic conductivity of 1.0 gal/day/ft². Figure VI-4 shows the predicted flow of Moyer Springs Creek under these assumptions. The principal impact of spoil hydraulic conductivity is on the recovery of potentiometric surface. Figure VI-5 shows the recovery of the potentiometric surface at column 18, row 14, after 36 years of mining have been simulated. With an assumed spoil hydraulic conductivity of 5.0 gal/day/ft², the recovery of the potentiometric surface is relatively rapid; recovery being essentially complete within 100 years. With an assumed spoil hydraulic conductivity of 0.2 gal/day/ft², the recovery of the potentiometric surface is very slow; recovery takes well



VI-5

Figure VI-3.--Moyer Springs Creek's flow assuming a lower specific yield in the scoria.



VI-4

Figure VI-2.--Moyer Springs Creek's flow assuming a lower hydraulic conductivity in the scoria.

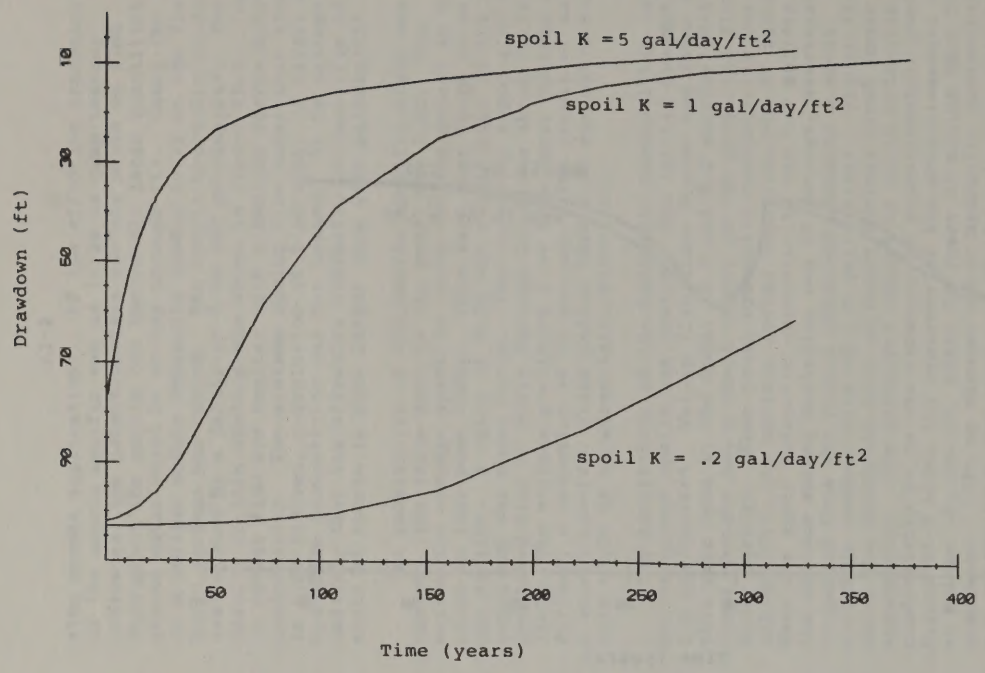


Figure VI-5.--Recovery of water levels assuming different hydraulic conductivities for spoil material.

VI-7

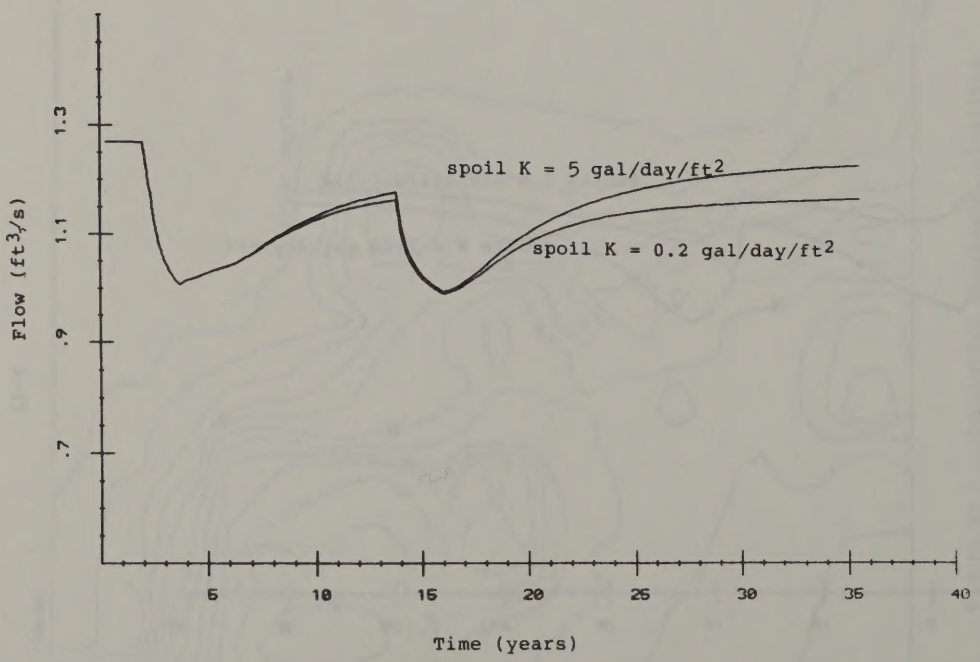


Figure VI-4.--Moyer Springs Creek's flow assuming lower and higher hydraulic conductivities of spoil.

VI-6

over 300 years. The recovery of Moyer Springs will be affected in a similar manner; there will be a small depletion of spring flow until recovery is complete.

The assumed ground-water discharges to surface water and to evapotranspiration are another source of uncertainty in the model. Stream gaging data indicates that the average flow of Moyer Springs is 0.89 ft^3/sec, and the average outflow of Moyer Springs Creek is 1.27 ft^3/sec. The other ground-water runoff values in the model are estimates from the Dry Fork mine permit application and from estimates based on the potential evapotranspiration rate. Due to the uncertainty in these estimates of ground-water runoff, a sensitivity analysis was performed. All ground-water discharges, except those along Moyer Springs Creek (where accurate data exist), were reduced by a factor of 2 and the model was rerun. The reduction was made by halving the recharge factor (R). This change resulted in negligible (less than 1 percent) difference in the predicted spring depletion or in predicted drawdowns.

The assumed hydraulic conductivity of the coal aquifer was suspected to be a sensitive parameter. The average hydraulic conductivity used in the model runs was 7.60 $gal/day/ft^2$. This value was derived (see chapter II) by averaging out the results of pump tests as reported in the various mine permit applications. The majority of the pump tests included in the database were single-well, short-term tests. There is some evidence that single-well, short-term (less than 4 hours) pump tests yield lower values than long-term, multiwell pump tests. There were 50 pump tests of the coal aquifer in the data base that were less than 4 hours in duration. The geometric mean of these values was 4.35 $gal/day/ft^2$. There were seven pump tests of the coal aquifer between 1 and 1.5 days. The geometric mean value was 21.11 $gal/day/ft^2$. The data base contained 20 single-well drawdown tests, 32 single-well recovery tests, and 25 observations from multiwell tests. The respective geometric means were 7.49, 3.71, and 17.88 $gal/day/ft^2$. Thus, it is possible that the coal aquifer hydraulic conductivity may be larger than assumed. Another factor affecting the pump test data base is that only pump tests that reported a transmissivity value were included. Tests of low-yielding wells that could not be successfully tested were excluded from the database. Thus, the coal aquifer hydraulic conductivity could also be smaller than assumed. A coal aquifer hydraulic conductivity of 15.2 $gal/day/ft^2$ was inserted in the model and the model rerun in an effort to see if a larger assumption for coal aquifer hydraulic conductivity would cause a larger impact on Moyer Springs. The results of this sensitivity analysis are that Moyer

Springs depletion increased only slightly; the maximum flow reduction was 26 percent.

The position of the mine pit was fixed for each 2-year period. Typically, five or six grid nodes were mined within a 2-year period. The actual position of the mine pit in the area mined was arbitrary. A sensitivity analysis was performed to see if moving the assumed position of the mine pit closer to Moyer Springs had any large impact on the predicted Spring depletion. The closest approach of the Dry Fork mine pit to Moyer Springs was in the sixteenth year of the mine plan. The mine pit was assumed to be in grid node column 17, row 16. Moyer Springs was in grid node column 17, row 18. The mine pit was moved to column 17, row 17, within 500 feet of Moyer Springs to test the sensitivity of spring depletion to the assumed mine pit location. The results of this run indicate only a slight increase in Spring depletion (less than 1 percent).

The sensitivity analysis indicates that the predictions of the impact of mining on the flow of Moyer Springs are relatively insensitive; changing the model input parameters within reasonable bounds has relatively little impact on predicted depletion.

VII. Conclusions

The principal accomplishments, assumptions, and conclusions of this study are:

1. A modified version of the OSMRE ground water model (a version of the Prickett-Lonnquist finite difference model) was applied to the coal/scoria aquifer around the Dry Fork mine. The objective of the modeling effort was to predict the cumulative hydrologic impact of mining on the flow of Moyer Springs.

2. The maximum reduction in the flow of Moyer Springs caused by the cumulative effects of mining (the Buckskin, Rawhide, Eagle Butte, Dry Fork, East Gillette, Clovis Point, Fort Union Pits No. 1 and No. 2, and Wyodak mines) was predicted to be 25 percent. The maximum reduction in the average outflow of Moyer Springs Creek was predicted to be 22 percent. There will be a small depletion of spring flow for hundreds of years after reclamation takes place as water levels in the coal aquifer recover.

3. The maximum reduction in the flow of Moyer Springs caused by the cumulative effects of mining not including the Dry Fork mine was predicted to be 4.5 percent . The maximum reduction in the average flow of Moyer Springs Creek was predicted to be 5.1 percent. These maximum depletions occur after all mining in the area is finished while the potentiometric surface is recovering. There will be a small depletion of spring flow for hundreds of years after reclamation takes place as water levels in the coal aquifer recover.

4. The predictions of the impact on spring flows due to mining are insensitive; they are not highly dependent on the model parameter assumptions. Moyer Springs depletion due to mining is not likely to exceed 30 percent. These impact predictions are similar to those in the Dry Fork mine permit application.

5. Drawdowns around the Dry Fork mine will be large because of the cumulative impact of mining in the area. The coal aquifer will be removed by mining and the water levels lowered to the bottom of the coal aquifer. The drawdown predictions made in this report are much larger than those in the Dry Fork mine permit application. The drawdown predictions are relatively sensitive to the model parameter assumptions.

VIII. References

1. Freeze, R. A., and Cherry, J. A., 1979, Groundwater: Englewood Cliffs, N.J., Prentice-Hall Inc.

2. Frontier Coal Company, 1984-85, Application for permit, Fort Union mine (pits Nos. 1 and 2): vols. 1-18, submitted to the Office of Surface Mining, 1984-85.

3. Gillette Area Ground-water Monitoring Organization (GAGMO), 1985, Annual Report.

4. Office of Surface Mining, 1981, Ground Water Model Handbook: Western Technical Service Center.

5. Phillips Petroleum Company, 1982-86, Application for permit, Dry Fork mine: vols. 1-21, submitted to the Office of Surface Mining, 1982-86.

6. Prickett, T. A., and Lonnquist, C. G., 1971, Selected Digital Computer Techniques for Groundwater Resource Evaluation: Bulletin 55, Illinois Water Survey.

APPENDIX E

PUBLIC COMMENT LETTERS

Seventeen comment letters regarding the EIS were received by OSMRE during the April 11, 1988, to June 13, 1988, comment period. These letters are reproduced in full on the pages listed below. Specifically, OSMRE received letters from:

United States Department of the Interior

BUREAU OF MINES

P. O. BOX 25086
BUILDING 20, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

Intermountain Field Operations Center

May 17, 1988

Memorandum

To: Raymond L. Lowrie, Assistant Director, Office of Surface Mining Reclamation and Enforcement, Western Field Operations, Brooks Towers, Second Floor, 1020 - 15th Street, Denver, Colorado 80202
Attention: Floyd McMullen

From: Chief, Intermountain Field Operations Center

Subject: Proposed mining plan, Dry Fork Mine, Campbell County, Wyoming - draft environmental statement OSMRE-EIS-24

We received a copy of the subject draft environmental impact statement (EIS) and appreciate the opportunity to comment on the proposed mining plan. A discussion of local mineral resources is included in the chapter entitled "Description of the Affected Environment," and impacts to mineral resources are reviewed separately under discussions of each alternative plan. Three active oil wells, two oil pipelines, and one gas pipeline occur in the proposed coal mine area. In addition, approximately 3.8 million bank cubic yards of a local scoria resource would be consumed during the life of the mine. Impacts to all resources are adequately discussed in the EIS with the exception of impacts to the three pipelines. Two pipelines crossing the proposed mine area are owned by the mine operator (Phillips Petroleum Company); one, however, is owned by another company, and impacts to it especially need to be addressed. We, therefore, recommend that the final version of the EIS include information regarding plans for protection or relocation of all pipeline routes potentially affected by the mine operation. Otherwise, we have no objection to the document as presented.

William Cochran

United States Department of the Interior
BUREAU OF RECLAMATION
Missouri Basin Region
P.O. Box 36900
Billings, Montana 59107-6900

IN REPLY REFER TO: MB-152

Memorandum

To: Director, Western Field Operations, Office of Surface Mining, Reclamation and Enforcement, Denver, Colorado

From: Regional Environmental Affairs Officer, Billings, Montana

Subject: Draft Environmental Impact Statement (DEIS) Proposed Dry Fork Mine, Campbell County, Wyoming (OSMRE - EIS - 24) (DES 88/22)

We have reviewed the subject mining proposal DEIS and have determined that the activity will not affect any Bureau of Reclamation projects or facilities. We have no substantive comments on the DEIS.

Robert Schroeder

United States Department of the Interior
NATIONAL PARK SERVICE
ROCKY MOUNTAIN REGIONAL OFFICE
12795 W. Alameda Parkway
P.O. Box 25287
Denver, Colorado 80225-0287

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

L7619 (RMR-PP)

JUN 3 1988

Memorandum

To: Assistant Director, Office of Surface Mining Reclamation and Enforcement, Western Field Operation, Denver, Colorado

From: Associate Regional Director, Planning and Resource Preservation, Rocky Mountain Region

Subject: Draft Environmental Impact Statement (DEIS) Proposed Mining Plan, Dry Fork Mine Campbell County, Wyoming (DES 88/22)

We have reviewed the subject document and have no comments. Our main concerns, air quality and impacts to visibility at Devils Tower National Monument, have been well covered in the DEIS.

Robert J. Albens, acting
for Richard A. Strait

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
Wyoming State Office
2120 Capitol Avenue, Room 7010
Cheyenne, Wyoming 82001

IN REPLY REFER TO:

FWE-61410

June 7, 1988

MEMORANDUM

To: OSMRE, Western Field Operations, Denver, CO
Attention: Floyd McMullen

From: State Supervisor, Wyoming State Office, USFWS, Cheyenne, WY (FWE-61411)

Subject: Review of Draft EIS for Proposed Mine Plan, Dry Fork Mine

We have reviewed the subject document and believe it adequately addresses fish and wildlife concerns. We strongly support alternative two since it adequately mitigates impacts to raptors, wetlands, and fisheries in Mayer Springs Creek.

R.G. Starkey

R. G. Starkey

cc: BFA (ERT), Washington, D.C.

United States
Department of
Agriculture

Soil
Conservation
Service

Federal Building, Room 3124
100 East B Street
Casper, Wyoming 82601

May 12, 1988

Mr. Raymond L. Lowrie, Assistant Director
Office of Surface Mining
Reclamation and Enforcement
Western Field Operations
Brooks Towers, Second Floor
1020 15th Street
Denver, Colorado 80202

Dear Mr. Lowrie:

The Soil Conservation Service in Wyoming has no comment on the draft Environmental Impact Statement for the Proposed Mining Plan, Dry Fork Mine, Campbell County, Wyoming.

We thank you for the opportunity to review the document.

Sincerely,

FRANK S. DICKSON
State Conservationist

cc:
Mr. James B. Newman, Director, Ecological Sciences Division,
Soil Conservation Service, Washington, D.C.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Office of the
Regional Director

Region VIII
Federal Office Build
1961 Stout Street
Denver CO 8029

May 18, 1988

Mr. Raymond L. Lowrie, Assistant Director
Office of Surface Mining Reclamation and Enforcement
Western Field Operations
Brooks Tower, Second Floor
1020 - 15th Street
Denver, Colorado 80202
Attention: Floyd McMullen

Dear Sir:

The various Operation Divisions of the Regional Office have reviewed the Draft Environmental Impact Statement for the Proposed Mining Plan, Dry Fork Mine, Campbell County, Wyoming.

We concur with the following statements under Item H, Socioeconomic, 6.Human Services and Health Care Facilities on page III-26. "Whereas these facilities are adequate, they are understaffed. In general, staffing for human services has not been adequate to existing demand in the county." Therefore it is our recommendation that adequate staffing be accommodated in the plan.

Elwyn Holtrop
Regional Special Programs Coordinator

U.S. Department of Housing and Urban Development
Denver Regional/Area Office, Region VIII
Executive Tower Building
1405 Curtis Street
Denver, Colorado 80202

April 26, 1988

Mr. Raymond L. Lowrie, Assistant Director
(Attention: Floyd McMullen)
Office of Surface Mining
1020 - 15th Street
Denver, Colorado 80202

Dear Mr. Lowrie:

This is in response to your request for comments on the Proposed Mining Plan, Dry Fork Mine, Campbell County, Wyoming, Draft Environmental Impact Statement (DEIS).

Your DEIS has been reviewed with consideration for the areas of responsibility assigned to the Department of Housing and Urban Development. This review considered the project's impact on housing and community development. The DEIS indicates that Gillette and the surrounding Campbell County area would only experience minor short term impacts on housing and community facilities from the proposed action. This is based on the anticipation that the current surplus of housing units is likely to dwindle, with the need for housing possibly peaking in 1994. Within these parameters, we find this document adequate for our purposes.

A further concern that this office would point out, particularly regarding the Rawhide subdivision located west of the proposed action, is that local government carefully review any new subdivision proposals in nearby unincorporated areas to assure there are no potential hazards from methane or hydrogen sulfide gas seeps.

If we can be of further assistance, please contact Mr. Howard Kutzer, Regional Environmental Officer, at (303) 844-3102.

Very sincerely yours,

Robert J. Matuschek

Robert J. Matuschek
Director
Office of Community
Planning and Development

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

JUN 1 3 1988

Ref: 8PM-EP

Raymond L. Lowrie, Assistant Director
Office of Surface Mining
Reclamation and Enforcement
Western Field Operations
Brooks Towers, Second Floor
1020-15th Street
Denver, Colorado 80202

Attention: Floyd McMullen

RE: Draft Environmental Impact Statement (DEIS) for Dry Fork Mine, Campbell County, Wyoming

Dear Mr. Lowrie:

In accordance with the National Environmental Policy Act (NEPA) and our responsibilities under Section 309 of the Clean Air Act, the Region VIII Office of the Environmental Protection Agency (EPA) has reviewed the referenced DEIS. The coal mine would eventually cover 3,798.49 acres near Gillette in northeastern Wyoming. We have appreciated the opportunity to discuss the project with your staff during our review. We would like to commend your office for including detailed information on air quality, hydrology, fisheries, and cumulative impacts.

Based on our concerns and the criteria EPA has established to rate adequacy of draft EISs, we have rated this draft EIS as Category EC-2 (environmental concerns-insufficient information). A summary of our EIS rating definitions is enclosed along with our detailed comments. The primary areas of EPA concern include:

- protection of the Moyer Springs Creek fishery (including clarification of predicted water quality effects) under the Wyoming water quality standards program and the Clean Water Act as amended by the Water Quality Act of 1987,

- additional information on types of wastes to be produced and how they will be managed to protect ground water resources,

- protection of water resources from aboveground or underground storage tanks,

- o need for a 24-hour air quality analysis for both the mine and cumulative emissions, and
- o adequate delineation and mitigation of wetland losses.

We would welcome the opportunity to work with your staff in addressing EPA concerns prior to the final EIS. Contact Doug Lofstedt of my staff as needed (293-1462) for further EPA assistance.

Sincerely,

for Robert R. DeSpain, Chief
Environmental Policy Branch
Office of Policy and Management

Enclosure

cc: Wyoming Department of Environmental Quality

EPA DETAILED COMMENTS ON THE DRAFT
ENVIRONMENTAL IMPACT STATEMENT ON THE PROPOSED
MINING PLAN, DRY FORK MINE, CAMPBELL COUNTY, WYOMING

Aquatic Resources, Ground Water

The DEIS notes the cold water aquatic life beneficial use (Class II) assigned to Moyer Springs Creek by the State of Wyoming water quality standards (WQS) (page III-7). The six existing coal mines and two planned mines are predicted to reduce flows of Moyer Springs and Moyer Springs Creek by a maximum of 25 percent and 22 percent (years 4 and 15 of the Dry Fork Mine operation). The Dry Fork Mine alone is projected to cause 20 percent of the reduction. Average depletion would be about 13 percent over the life of the mine and "less than 5 percent for as long as 200 years after reclamation" of all eight mines (page IV-16). However, Condition No. 2 of the Permit to Mine Coal would require replacement of the trout fishery " 'If the capacity of Moyer Springs to support trout is significantly diminished . . . with a similar stream environment in a suitable location within Campbell County' " (if restoration is not possible) (page A-20). The condition does not appear to be consistent with compliance with the existing Class II cold water fishery beneficial use protected under the State WQS and the Clean Water Act as amended by the Water Quality Act of 1987 (CWA/WQA). Since the cold water fishery is an existing beneficial use, State procedures for downgrading or removing the use do not apply. Also note requirements for Federal agency compliance with WQS via CWA/WQA Section 313.

We feel that every effort should be made to preserve this unique aquatic/hydrologic environment. The Office of Surface Mining Reclamation and Enforcement policy for long and short term protection of the resource should be described. It appears that alterations of mining procedures would enable use of pumped water from mine pits (page IV-22) to augment Moyer Springs Creek flow when needed. One suggestion for minimizing impacts on the local hydrologic regime would be to orient the mine pit parallel to the dip of the coal seam and thus to the direction of ground water flow (dipline mining). This would reduce the amount of ground water intercepted by the active pit and thereby reduce effects on the local aquifer. To effectively implement protection of the beneficial use, we recommend the final EIS provide some specific threshold levels of allowable impact, e. g., temperature, fish population, habitat, etc. If there is significant impact over the short-term, a request for a WQS variance would be needed. If the lease holder has the responsibility to monitor, who determines WQS compliance during and after mining?

The summary comparison of water quality impacts (pages IV-65, 70) does not appear to be consistent with the narrative. The summary predicts a "negligible" short and long-term impact. However, the Wyoming Department of Environmental Quality (DEQ) apparently is anticipating a substantial increase in salinity after mining (page IV-18). The impact on WQS beneficial uses should be described since the narrative tends to just address compliance with the WQS numeric criteria. Furthermore, we suggest the EIS more clearly explain the two

components of WQS, notably the numeric criteria (or "limits") and beneficial uses. How will the post-mining decrease in water quality be addressed? The effects of reduced flow in Moyer Springs Creek on water quality appear to be contradictory. Increases in temperature and a reduction in turbulence and "coefficient of reaeration and thus lower dissolved oxygen concentrations" are stated on page IV-19. However, Phillips Petroleum Company (PPC) found that "decreasing creek flow would not affect oxygen concentrations in the creek ..." (page IV-28). The degree of impact from reduced flows should be clarified since it is not clear what "negligible" means. We suggest that surface water data be consolidated in one area.

The final EIS should clarify the types and quantities of solid wastes which will be produced and exactly how the wastes will be disposed of. Solids from the two lined evaporation ponds will be selectively placed in the mine backfill. These solids from facility washdown waters have the potential to be quite toxic. Will regular analyses be run on the solids? How will this material be selectively placed in the mine backfill? The statement that "Any toxic solid waste and any carbonaceous material would be disposed of in the mine backfill or by a private contractor at an authorized disposal site" (page A-3, first paragraph) needs to be clarified. Which toxic material will be dumped in the mine backfill and which will be hauled off to an authorized disposal site?

PPC will bury the most undesirable spoil (highly carbonaceous units, coal rider seams, and other toxic material as necessary) in designated areas at the base of the pit and seal it with an impermeable layer of non-toxic material (page IV-15, first paragraph). Will these designated areas be lined and/or excavated into impermeable stratigraphic units so as to minimize downward and lateral leaching? Sealing this material with an impermeable cap may not prevent leachate development and subsequent ground water contamination. As the water table aquifer recovers, this toxic spoil could leach contaminants into the ground water regardless of its impermeable cover.

It is important to determine the source(s) of recharge water for the post-mining spoil aquifer to ensure proper placement of acid-forming and toxic material in the spoil. In the case of Dry Fork, a major source of recharge to the spoil aquifer will be from precipitation infiltration and leakage from the Dry Fork of the Powder River. Therefore, acid-forming spill should be place at depths below the predicted post-mining water table where seasonal wet-dry cycles will not continue to oxidize the acid-forming material.

Consolidated overburden and coal at the mine will be blasted with an ammonium nitrate-fuel oil mixture (ANFO). ANFO has the potential to pollute both ground and surface water in the area via spillage, incomplete explosion, or stockpile/spoil residual contamination. Therefore, any ANFO spills should immediately be cleaned up and records should be maintained of such incidences. We suggest sampling the pit water on a regular basis (weekly) for ANFO constituents to assure ground water/surface water contamination is not occurring.

The 800 foot long, 15 percent slope on the ridge in the southeast corner of the permit area presents an erosion control concern. The final EIS should state whether an overstripping agreement has been reached with Fort Union pit No. 2, and, if so, the effect on the slope gradient. In either case, we suggest the final EIS specify in more detail the erosion standards to be achieved.

The EIS briefly describes the fuel storage system to be used (page A-2). Two above ground storage tanks with a combined capacity of 150,000 gallons will hold diesel fuel. Three underground storage tanks will hold 20,000 gallons of gasoline, 36,000 gallons of lubricants, and 6,000 gallons of waste oil. A discussion should be included on the types of structures to be constructed around the above ground storage tanks to prevent and/or minimize soil, ground water, and surface water contamination should one of these tanks leak or rupture. Although the underground storage tanks will be regulated by the Underground Storage Tank (UST) program, a brief description of exactly where they will be placed and how they will be monitored for leak detection should be included.

Twenty-eight core holes were drilled within the mine area. Depending on the specific core, various Wyoming DEQ guideline recommendations were exceeded in many of the cores (page III-4). The monitoring and sampling of regraded spoil to 4 feel below the surface is an acceptable method for assuring that the upper spoil will support vegetation. It is not clear however, how PPC will determine what portions of the overburden stockpile have high toxicity and what portions are less toxic therefore requiring selective backfilling. Will the overburden be analyzed on a regular basis as it is excavated and then placed in separate piles of toxic, less toxic, and non-toxic spoil? Also, the final EIS should clarify "less toxic spoil" (page IV-15). The placement of this material below the vegetation rooting zone and above the ground water potentiometric surface does not prevent if from acting as a ground water contamination source from precipitation infiltration.

Air Quality, Visibility

The DEIS only contains the annual air quality analysis. The final EIS should contain a 24-hour air quality analysis for both the Dry Fork Mine and cumulative emissions from all eight surface mines in the area. The modeling should address the PM-10 National Ambient Air Quality Standard (NAAQS) per 40 CFR Part 51.160, as well as the Wyoming TSP standards. The modeling should include receptors in Gillette to ensure that the PM-10 NAAQS will not be exceeded.

Wetlands

We suggest a brief description on page III-11 of the existing wetland characteristics and values. Mining would destroy 38.2 acres of "subirrigated" wetlands in drainages other than Moyer Springs Creek (page IV-27). Consequently, impacts to wetlands may constitute more than "minor impacts" to "bottomland vegetation (site-specific)" (page ix).

Reclamation would restore "24.6 acres of natural flood-irrigated land and riparian vegetation and 62.8 acres of subirrigated land and wetland vegetation" (page IV-27). It is unclear just how much of the 62.8 acres of subirrigated land is classified as wetlands. Consequently, it is not clear that reclamation actually "would increase wetland vegetation by 24.6 acres" (page IV-27). The EIS should be more specific in describing how the new wetlands will be equivalent to the original. Use of a recognized classification system, such as developed by Cowardin, et al. (U.S. Fish and Wildlife Service, 1979), would help facilitate an objective comparison. Given the uncertainty of success for the new wetlands, we recommend a wetland creation to loss ratio of at least 2:1. The need for off-site mitigation should be considered depending on the values lost versus replacement value. The EIS should address how mitigation will proceed concurrently with mining.

It is unclear whether there are wetlands under Corps of Engineers (COE) jurisdiction for the CWA/WQA Section 404 dredge and fill program, i.e., waters of the United States, and whether mining of the wetlands will require a 404 permit from the COE. If applicable, the EIS should describe the type of permit needed, consultation with the COE, how the 404 permit requirements would be integrated into the mining and reclamation plans, and required notification of the COE if the project will be done under a Nationwide permit authorization (33 CFR Part 330.7). The only coal mining exemption from the 404 program applies to "temporary roads for moving mining equipment" (under certain conditions) (33 CFR Part 323.4(a)(6)). Exceptions to the exemption address discharges of toxic pollutants or when any discharge "incidental" to exempted road construction is "part of an activity whose purpose is to convert an area of the waters of the United States into a use to which it was not previously subject, where the flow or circulation of waters of the United States may be impaired or the reach of such water reduced" (Part 323.4(b) and (c)).

Other Comments

The Dry Fork of the Little Powder River runs through portions of the northwest, southwest, and south advance areas. This drainage channel and tributary channels will obviously need to be reconstructed to mimic as closely as possible pre-mining subsurface stratigraphy and surficial topography. A discussion should be included in the EIS on how these drainage channels will be reconstructed to assure their future preservation. An accompanying map of all the drainage channels in the area of disturbance should also be included.

"Review of Federal Actions Impacting the Environment," EPA, Office of Federal Activities, Washington, D.C., October 3, 1984.

SUMMARY OF RATING DEFINITIONS
AND FOLLOW-UP ACTION

Environmental Impact of the Action

LO--Lack of Objections
The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC--Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO--Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU--Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1--Adequate
EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2--Insufficient Information
The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3--Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

THE STATE OF WYOMING

MIKE SULLIVAN
GOVERNOR

1890-1990 WYOMING CENTENNIAL A LASTING LEGACY

Department of Environmental Quality

Administration	Air Quality Division	Land Quality Division	Solid Waste Management Program	Water Quality Division
(307) 777-7937	(307) 777-7391	(307) 777-7756	(307) 777-7752	(307) 777-7781

MEMORANDUM

TO: Raymond L. Lowrie, Assistant Director
Office of Surface Mining

FROM: Randolph Wood, Director RW by ma
Department of Environmental Quality

DATE: June 1, 1988

SUBJECT: Review and comments on the Draft EIS for Dry Fork Mine, Campbell County, Wyoming

John Wagner and Susan Fields provided the following comments on the above referenced project:

1. Permits to construct and NPDES permits were issued for sedimentation ponds in 1985. These permits are valid for five years. The company will need to apply for renewal in February, 1990 if the facilities are not constructed by the five year deadline.

2. A permit to construct must be obtained for the proposed sewage treatment facility. If the facility is to discharge to surface water, a NPDES permit will also be required.

/nc

Herschler Building • 122 West 25th Street • Cheyenne, Wyoming 82002

THE STATE OF WYOMING

MIKE SULLIVAN
GOVERNOR

1890-1990 WYOMING CENTENNIAL
A LASTING LEGACY

Department of Environmental Quality

Herschler Building • 122 West 25th Street • Cheyenne, Wyoming 82002

Administration	Air Quality Division	Land Quality Division	Solid Waste Management Program	Water Quality Division
(307) 777-7937	(307) 777-7391	(307) 777-7756	(307) 777-7752	(307) 777-7781

June 7, 1988

Raymond L. Lowrie, Assistant Director
Office of Surface Mining, Reclamation
and Enforcement
Western Field Operations
Brooks Towers, Second Floor
1020 15th Street
Denver, Colorado 80202

RE: Phillips Dry Fork Mine Draft Environmental Impact Statement

Dear Mr. Lowrie:

Enclosed are comments on the subject DEIS from the Wyoming State Geologist, forwarded to this office by the State Planning Coordinator.

We would appreciate the consideration of Mr. Glass's concerns in the preparation of the final document. Thank you.

Sincerely,

Gregory Smith
Principal Analyst
Land Quality Division

GS:k

Enclosure

cc: Alan Edwards - Governor's Office
Bob Giurgevich
Rick Engelmann
Rick Chancellor
Rosann Poltrone

THE STATE OF WYOMING

MIKE SULLIVAN
GOVERNOR

Game and Fish Department

BILL MORRIS
DIRECTOR

June 6, 1988

EIS 0848
United States Department of the Interior
Office of Surface Mining Reclamation and Enforcement
Draft EA - Proposed Mining Plan,
Dry Fork Mine
Control No. 020488
SIN: 88-023
Campbell County

Alan Edwards
State Planning Coordinator's Office
Herschler Building, 2nd Floor East
Cheyenne, WY 82002

Dear Mr. Edwards:

The staff of the Wyoming Game and Fish Department has reviewed the Draft Environmental Impact Statement for the Dry Fork Mine in Campbell County. We offer the following recommendations for the protection of fish and wildlife resources.

Terrestrial Concerns:

The Draft Environmental Impact Statement adequately addresses wildlife concerns and issues associated with the proposed Dry Fork Mine north of Gillette. WGFD participated in the review and analysis of this permit through a cooperative agreement under the Wyoming State Coal Program. Our initial completeness review was submitted to DEQ on August 30, 1982. Technical comments were forwarded in memoranda dated April 30 and November 8, 1984. All issues were satisfactorilly resolved and incorporated into the mine plan. Wildlife portions of the technical environmental assessment were completed on June 10, 1986.

Although OSM has identified Alternative 1 as the preferred alternative, we support the stipulations outlined under Alternative 2. Alternative 2 contains additional measures to: 1) minimize impact upon Moyer Springs; 2) protect breeding

Headquarters: 5400 Bishop Boulevard, Cheyenne, Wyoming 82002

raptors during the operational phase of mining; and 3) require construction of raptor nest platforms to replace mature cottonwood trees (eliminated by mining) until seedlings reach sufficient size. The final stipulation would require the operator to maintain the physical condition and stability of a nest platform to which the Dry Fork eagle pair's nest was relocated. The stipulations originated at the federal level augment protective measures identified by the state during the original permit review.

Aquatic Concerns:

Our primary fishery concern with this project is the maintenance of the wild brook trout fishery in Moyer Spring Creek. We compliment OSM on the consideration given this unique Campbell County resource in the DEIS. We feel that this consideration is justified and have previously provided information supporting the need to maintain Moyer Spring Creek. We have determined that Alternative 2 will adequately mitigate potential fishery impacts. Condition #10 of this alternative (page II-3), however, may not be desirable for the entire life of the project. When public access to the stream does not create an inconvenience for mining operations and public safety is not a major concern, some level of fishing might be allowed. At that time, regulations could be established by our Department controlling the harvest of fish. Our Department is willing to work closely with the Phillips Petroleum Company to design and implement fishing regulations to maintain the wild brook trout population in Moyer Spring Creek. We therefore recommend selection of Alternative 2 with deletion of condition #10. Permanent public access to the stream at the end of mining operations is also desirable. We would be willing to work with the Phillips Petroleum Company to achieve this objective.

Thank you for the opportunity to comment on this proposal as you develop the state's final recommendations.

Sincerely,

Francis Petera

FRANCIS PETERA
ASSISTANT DIRECTOR
OPERATIONS

FP:SCT:as
cc: Game Div.
Fish Div.
HATS Div.
USF&WS - Cheyenne

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THE GEOLOGICAL SURVEY OF WYOMING
UNIVERSITY OF WYOMING
BOX 3008, UNIVERSITY STATION
LARAMIE, WYOMING 82071
(307) 742-2054 (307) 721-3920 (307) 766-2286

MEMORANDUM

To: Alan Edwards
State Planning Coordinator's Office
From: Gary B. Glass, State Geologist
Subject: Proposed mining plan, Dry Fork Mine,
Campbell County, Draft EIS
Date: May 2, 1988

We have reviewed the DEIS on the Dry Fork proposed mining plan and submit the following comments:

Page vii, 1st paragraph - It should be noted that the Clovis Point mine is now inactive or "idled". Appendix B, part B (p.B-2) should reflect this also.

Page II-2, Condition 7 - Does this condition also refer to previously unidentified vertebrate fossils? Both the Federal government and the State have laws protecting vertebrate fossils on their lands.

Page III-3, Part B. Geology, 1st line - More specifically, this mine is located "in the central portion of the eastern Powder River Basin", not the "central Powder River Basin" as it is now stated in the DEIS.

Page III-4, 3rd paragraph - It would have been helpful in assessing this mine plan if coal analysis data had been provided. Minimally, a range or average for proximate analyses, heat values, and sulfur are needed. A summary of ultimate analyses as well as major, minor, and trace elements in coal ash are also desirable.

Page IV-15, last paragraph - Are the writers of this DEIS familiar with the research by the Water Resources Division of the U.S. Geological Survey in Cheyenne, which addresses changes in selenium concentrations before and after mining?

. . . . .

Page IV-20, 4th paragraph - Without additional detailed information on the Shaw water well in SW¼, Section 31, T.51 N., R.71 W., we cannot adequately evaluate the DEIS comments. While the well may not go dry due to the mining, other things could happen to it. What happens if the well is rendered useless?

Pages IV-47 and IV-48, Section b. - We may be missing the point, but there does appear to be a contradiction between the two paragraphs in this section. In the first paragraph, it is stated that "an augmentation well would not mitigate the increase in salinity . . . that may occur after the potentiometric surface has recovered". In the second paragraph, it is stated "that with an augmentation well, the impact of mining . . . on the quality of water . . . would be negligible over both the short and long terms". Rewording or further explanation is needed.

Pages V-3 and V-4, Natural gas seepage from coal formations - In view of the recent problems at Rawhide Village north of Gillette, the potential for natural gas seepage in this area cannot be ignored. Minimally, some consideration should be given to surveying the mine area for venting gas before construction begins. Since there is a housing development only two miles to the south and since there are other mines between the Dry Fork mine and those houses, some monitoring for gas seepage may be warranted in and around the housing development to ensure the safety of people and property. An ounce of caution now could avoid expensive and dangerous future consequences.

Cross sections on Plate 3, which are admittedly not very detailed, show that the geologic setting at the Dry Fork mine is very similar to that at the Rawhide Village area, to include paleochannel areas. These similarities should be considered in the placement of mine facilities, especially those occupied by employees.

Similarly, there is a potential that shallow water wells might blow out as the water table is lowered. The DEIS notes that the water table will be drawn down.

To adequately mitigate these concerns, they must be addressed prior to mining. We do not feel that the issue of natural gas seepage can be ignored as stated in the DEIS. Our point is that while the causes of gas seepage may be unclear, there are testing methods that can document the presence or absence of venting gases. Periodic monitoring for gas seepage in and near mine facilities or other occupied areas is a prudent effort. Our concern, incidentally, goes beyond the Dry Fork mine property. In the case of the Dry Fork mine, we are most concerned about occupied facilities on the mine property as well as occupied dwellings adjacent to all sides of the property. In other areas, we are concerned with any occupied dwellings adjacent to active mines. We do understand that this latter concern goes beyond the obligations of the Dry Fork mine.

Page A-5, Section C - The mining sequence described in this section does not appear to agree with the life-of-the-mine disturbance sequence on page A-7 (Figure A-3). Can this be clarified?

STATE OF WYOMING
OFFICE OF THE GOVERNOR
CHEYENNE 82002

MIKE SULLIVAN
GOVERNOR

June 8, 1988

Mr. Raymond L. Lowrie, Assistant Director
Office of Surface Mining Reclamation and Enforcement
Western Field Operations
Brooks Towers, Second Floor
1020 15th Street
Denver, CO 80202

Re: Proposed Mining Plan - Dry Fork Mine, Campbell County, Wyoming

Dear Mr. Lowrie:

The EIS for the subject project has been circulated for review by the state agencies. Several comments were received which are forwarded herewith for your information and consideration. Thank you for the opportunity to be involved in your review process.

Sincerely,

Alan Edwards

Alan Edwards
Natural Resource Analyst

AE:sj
Enclosures
cc: Greg Smith, Land Quality Division

MIKE SULLIVAN
GOVERNOR

1890-1990 WYOMING CENTENNIAL A LASTING LEGACY

Wyoming State Archives, Museums & Historical Department

DAVID KATHKA, Ph.D.
DIRECTOR

BARRETT STATE OFFICE BUILDING • CHEYENNE, WY 82002 • (307) 777-7519

May 19, 1988

COPY

Mr. Richard Miller
State Planning Coordinator
Herschler Building
Cheyenne, Wyoming 82002

RE: Dry Fork Mine DEIS

Dear Mr. Miller:

Rheba Massey and Richard Bryant of our staff have reviewed the DEIS and other documents relating to this project. We agree that the project area has been adequately surveyed for cultural resources. The following sites are not eligible for the National Register and no specified protection measures are necessary:

48CA305	48CA917	48CA922
48CA306	48CA918	48CA923
48CA914	48CA919	48CA924
48CA915	48CA920	48CA926
48CA916	48CA921	48CA972

Site 48CA521 consists of the remains of large mammal bones exposed in an erosional channel. It is uncertain whether this is a cultural site or whether it is just skeletal remains. The site should be relocated and tested to evaluate its cultural affiliation and National Register eligibility.

Prehistoric sites 48CA316 and 48CA925 meet the criteria of eligibility for the National Register of Historic Places (NRHP) and will be adversely affected by mine development. Prior to any physical disturbance of the sites, a data recovery plan must be developed and implemented to mitigated the adverse effects.

The following historic sites do not meet the criteria of eligibility for the NRHP and no special protection measures are necessary:

48CA307	48CA913
48CA910	48CA924
48CA911	48CA925 (historic component)
48CA912	48CA944

Site 48CA1272 (the Morgan Homestead) is considered eligible for the National Register but will not be directly affected by the mine development as presently planned. Increased traffice and visitation in this area may result in vandalism of this site. We recommend that the site be periodically monitored for vandalism and if it occurs, that a plan to protect the site be developed.

If you have any questions, please contact Mr. Bryant at 777-6292 or Ms. Massey at 777-6695.

Sincerely,

Thomas E. Marceau

Thomas E. Marceau
Deputy SHPO

FOR:
Dave Kathka, Ph.D.
State Historic Preservation Officer

TEM:RM:RLM:klm
cc: Department of Environmental Quality, Greg Smith
Office of Surface Mining/RE, Raymond L. Lowrie

THE STATE OF WYOMING

MIKE SULLIVAN
GOVERNOR

GORDON W. FASSETT
STATE ENGINEER

State Engineer's Office

HERSCHLER BUILDING CHEYENNE, WYOMING 82002

MEMORANDUM

May 26, 1988

TO: Alan G. Edwards, State Planning Coordinators Office

FROM: Richard G. Stockdale, Administrator, Ground Water Division

SUBJECT: Review of Draft EIS for Dry Fork Mine, State Identifier No. 88-023

The review of the subject report revealed nothing of particular significance with respect to the use or effects upon water resources in the area. The present method of assessing cumulative impacts caused by pumpage of ground water should probably be evaluated. As it now stands, the method utilized is a theoretical and totally unrealistic representation of the "real world" ground water system.

RGS:kks

THE STATE OF WYOMING

MIKE SULLIVAN
GOVERNOR

Water Development Commission

HERSCHLER BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

Michael K. Purcell
Administrator

Beryl Z. Churchill
William L. Glanz
Myron Goodson
Paul Hickey
Wayne Moore
J.W. Myers
Leslie Petersen
Merl Rissler
Kathleen Sun

TO: Alan Edwards, SPC Office

FROM: John W. Jackson, Deputy Administrator, Planning

DATE: May 27, 1988

SUBJECT: Review of Proposed Mining Plan, Dry Fork Mine, Campbell County, Draft EIS #88-023(a)

The impacts to the flows of Moyer Springs Creek and Dry Fork have been addressed and will not affect any WWDC Water Development Project.

The most likely area of conflict with a water project in that mining area is the City of Gillette pipeline and the Wyo-Dak Mine.

JWJ/cs
Attachments

Campbell County Economic Development Corporation
P.O. Box 3948
Gillette, Wyoming 82716
(307) 686-2603

June 6, 1988

Raymond L. Lowrie, Assistant Director
Office of Surface Mining
Reclamation and Enforcement
Western Field Operations
Brooks Towers, Second Floor
1020 15th Street
Denver, Colorado 80202
Attention: Floyd McMullen

Re: Proposed Mining Plan
Dry Fork Mine,
Campbell County, WY

Dear Mr. McMullen:

The Campbell County Economic Development Corporation, represents Campbell County and The City of Gillette.

We have reviewed, in detail, the Draft Environment Impact Statement OSMRE-EIS-24 concerning the proposed Dry Fork Mine.

Campbell County, including the City of Gillette can accommodate any socioeconomic impacts associated with the development of the mine. This is due to the infrastructure developed over the past twelve years, for the current mining operations.

The Campbell County Economic Development Corporation Board of Directors fully supports the issuance of a mining permit for the Dry Fork Mine.

Thank you.

Sincerely,

Loal R. Lorenzen
Executive Director

LRL/jnv

x/c: Dave Spencer, City of Gillette Community Development Department.